606. *Steroids. Part XIII.* Catalytic Hydrogenation of 3α- and 3β-Substituted Δ⁴-Steroids.*

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Catalytic hydrogenation of Δ⁴-steroids under various conditions leads to products of both the A/B-*trans*- and A/B-*cis*-series; the stereochemical influence of 3α- and 3β-substituents (OH, OAc, OMe, Cl, NHPh, and NH·CH_2Ph) is less marked than in hydrogenation of Δ⁵-steriods.

Whilst catalytic hydrogenation of 3β-substituted Δ⁵-steroids affords almost exclusively saturated compounds of the A/B-*trans*-series, it has recently been shown [1] that 3α-substituted Δ⁵-steroids give preferentially, and sometimes apparently exclusively, saturated compounds of the A/B-*cis*-series. It was therefore of interest to examine the influence of a series of 3β- and 3α-substituents on the stereochemical course of the catalytic hydrogenation of Δ⁴-steroids, although it was expected that, on account of the " half-chair " conformation [2] of ring A, any effects would be less marked than amongst Δ⁵-steroids. Since the stereochemical course of hydrogenation of Δ⁴-steroids is known to be affected by the character of the medium, *e.g.*, cholest-4-ene with platinum in a neutral solvent gives principally coprostane [3,4] but with platinum in an acidic medium exclusively cholestane,[4] experiments were carried out in ethyl acetate and in ethyl acetate containing acetic, sulphuric, or perchloric acid.

Schoenheimer and Evans [5] examined the hydrogenation of 3α- and 3β-hydroxycholest-4-ene with platinum in pentyl ether. Cholest-4-en-3α-ol gave a mixture of *epi*cholestanol, isolated by repeated crystallisation, and *epi*coprostanol, whose presence was established by epimerisation with sodium in xylene, separation of coprostanol with digitonin, and isolation of coprostanyl acetate; hydrogenation of cholest-4-en-3β-ol was incomplete and the products were inseparable, but evidence was adduced for the formation of coprostanol but not of cholestanol.

We have investigated the hydrogenation of cholest-4-enes with 3α-hydroxyl, 3α-methoxyl, 4α-acetoxyl, and 3α-benzamido-substituents and with 3β-hydroxyl, 3β-methoxyl, 3β-acetoxyl, 3β-chloro-, and 3β-anilino-substituents. 3α-Methoxycholest-4-ene could could not be prepared by methylation with silver oxide and methyl iodide of cholest-4-en-3α-ol, which gave mainly cholesta-3 : 5-diene; methanolysis of 3β-chlorocholest-4-ene gave

* Part XII, *J.*, 1957, 1451.

[1] Lewis and Shoppee, *J.*, 1955, 1365.
[2] Barton, Cookson, Klyne, and Shoppee, *Chem. and Ind.*, 1954, 21.
[3] Mauthner, *Monatsh.*, 1909, **30**, 635.
[4] Windaus, *Ber.*, 1919, **52**, 170.
[5] Schoenheimer and Evans, *J. Biol. Chem.*, 1936, **114**, 567.

a product, m. p. 45—46°, $[\alpha]_D$ +70°, provisionally termed 3α-methoxycholest-4-ene, but which, on account of the low value of its specific rotation, is probably a 1 : 1 molecular compound of 3α- and 3β-methoxycholest-4-ene analogous to that of 3α- and 3β-methoxycholestane described by Lewis and Shoppee.[6] The configuration of 3β-anilinocholest-4-ene was proved by the identity of its hydrogenation product *N-cyclo*hexylcholestan-3β-ylamine with that obtained by reduction of 3β-anilinocholest-5-ene (cholesterylaniline).[7] *N*-Benzylcholest-4-en-3β-ylamine was prepared, but in quantity insufficient for hydrogenation

TABLE 1.

Compound hydrogenated	Acid	Hydrocarbon(s)	Derivative of A/B-*cis*-series	Other products
Cholest-4-en-3α-ol	—	Cholestane (+ coprostane ?), 17%	*epi*Coprostanol, 33%	*epi*Cholestanol, 38%
	AcOH	Cholestane (+ coprostane ?), 8%	*epi*Coprostanol, 56%	*epi*Cholestanol, 32%
	H_2SO_4	Cholestane (+ coprostane ?), 78%	*epi*Coprostanol, 18%	*epi*Cholestanol, 4%
	$HClO_4$	Cholestane (+ coprostane ?), 94%	*epi*Coprostanol, 0%	*epi*Cholestanol, 5%
3α-Acetoxycholest-4-ene	—	Coprostane, 36%	*epi*Coprostanyl acetate, 48%	Oils, 16%
	AcOH	Coprostane, 28%	*epi*Coprostanyl acetate, 69%	Oils, 3% †
	H_2SO_4	Coprostane, 73%	*epi*Coprostanyl acetate, 15%	Oils, 10% †
	$HClO_4$	Coprostane, 85%	*epi*Coprostanyl acetate, 8%	Oils, 7% †
3α-Methoxycholest-4-ene	—	Coprostane + cholestane	—	Oils
N-Benzylcholest-4-en-3α-ylamine *	AcOH	—	*N*-(*cyclo*Hexylmethyl)-coprostan-3α-ylamine, 36%	*N*-(*cyclo*Hexylmethyl)cholestan-3α-ylamine, 41%

* Present as the benzylammonium cation. † Probably containing *epi*coprostanol.

TABLE 2.

Compound hydrogenated	Acid	Hydrocarbon(s)	Derivative of A/B-*trans*-series	Other products
Cholest-4-en-3β-ol	—	Oil, 3%	Cholestanol, 40%	Coprostanol, 50%
	AcOH	Oil, 2%	Cholestanol, 14%	Coprostanol, 78%
	H_2SO_4	Cholestane, 90%	Cholestanol, 5%	
	$HClO_4$	Cholestane, 96%	Cholestanol, 3%	
3β-Acetoxycholest-4-ene	—	Cholestane, 37%	Cholestanyl acetate, 53%	Oils, 10%
	AcOH	Cholestane, 19%	Cholestanyl acetate, 75%	Cholestanol, 6%
	H_2SO_4	Cholestane, 75%	Cholestanyl acetate, 7%	Cholestanol, 8%
	$HClO_4$	Cholestane, 91%	Cholestanyl acetate, 8%	
3β-Methoxycholest-4-ene	—	Cholestane, 24%	3β-Methoxycholestane, 66%	Oils, 10%
	AcOH	Cholestane, 35%	3β-Methoxycholestane, 60%	Oils, 5%
	H_2SO_4	Cholestane, 67%	3β-Methoxycholestane, 20%	Oils, 13%
	$HClO_4$	Cholestane, 84%	3β-Methoxycholestane, 8%	Oils, 8%
3β-Chlorocholest-4-ene	—	Cholestane, 100%	—	—
3β-Anilinocholest-4-ene *	AcOH	Cholestane, 9%	*N-cyclo*Hexylcholestan-3β-ylamine, 48%	Oils, 38%

* Present as the anilinium cation.

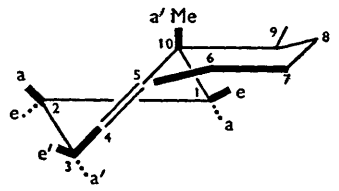
experiments; its configuration follows by exclusion from that of *N*-benzylcholest-4-en-3α-ylamine, which was established by the identity of its reduction products (*N-cyclo*hexylmethyl)cholestan-3α-ylamine and (*N-cyclo*hexylmethyl)coprostan-3α-ylamine with the known

[6] Lewis and Shoppee, *J.*, 1955, 1375.

[7] Lieb, Winkelmann, and Köppl, *Annalen*, 1934, **509**, 214; cf. King and Regan, *J. Amer. Chem. Soc.*, 1952, **74**, 5617.

compounds.[8] The results are summarised in Tables 1 and 2, which give the proportions of the hydrogenation products expressed as percentages of the total product.

Our results confirm and extend those of Schoenheimer and Evans.[5] In so far as the spatial requirements of a quasi-equatorial 3β-substituent increase hindrance by 2β-H (axial), 6β-H (axial), and 10β-Me (quasi-axial), and so reduce the accessibility to the catalyst of the β-face of ring A, the production of compounds of the A/B-*trans*-series is increased; conversely, in so far as the spatial requirements of a quasi-axial 3α-substituent increase hindrance by 1α-H (axial), 6α-H (equatorial), 7α-H (axial), and 9α-H (axial), the formation of compounds of the A/B-*cis*-series is increased, but the effects are less marked than amongst cholest-5-ene derivatives.



The presence of small amounts of acids during hydrogenation increases the rate of reaction but does not alter the stereochemical pattern. Acetic acid, unlike sulphuric or perchloric acid, notably decreases the extent of hydrogenolysis and correspondingly increases the yields of saturated substituted products.

Experimental

For general experimental directions see *J.*, 1957, 1451. $[\alpha]_D$ are in $CHCl_3$; ultraviolet absorption spectra are in EtOH solutions, with a Unicam SP. 500 spectrophotometer with corrected scale.

Cholest-4-en-3β-ol.—Cholest-4-en-3-one (m. p. 79—80°; 22 g.) was reduced with lithium aluminium hydride in ether at 36° according to the directions of Plattner, Heusser, and Kulkarni [9] to the molecular compound of the epimeric cholest-4-en-3-ols, m. p. 140—141°, $[\alpha]_D$ +83° (*c* 1·2), and cholest-4-en-3β-ol, m. p. 130—132°, $[\alpha]_D$ +46° (*c* 1·2). Acetic anhydride–pyridine at 15° (15 hr.) afforded 3β-acetoxycholest-4-ene,[5] m. p. 87—88°, $[\alpha]_D$ +8°, +10° (*c* 1·1, 1·8) [Found (after drying at 20°/0·03 mm. for 12 hr.): C, 80·9; H, 11·9. Calc. for $C_{29}H_{48}O_2$: C, 81·2; H, 11·3%], after recrystallisation from acetone.

3β-*Methoxycholest-4-ene.*—Cholest-4-en-3β-ol (2 g.) was refluxed with freshly prepared silver oxide (2 g.) in methyl iodide (30 c.c.) for 6 hr. The suspension was filtered, the filtrate evaporated in a vacuum, and the product taken up in ether; the ethereal solution was washed with sodium hydrogen sulphite solution and with water, dried, and evaporated. The oil soon crystallised, and by recrystallisation from acetone gave 3β-*methoxycholest-4-ene* (1·7 g.), m. p. 71—72°, $[\alpha]_D$ +41° (*c* 1·3) [Found (after drying at 40°/0·03 mm. for 10 hr.): C, 83·5; H, 11·8. $C_{28}H_{48}O$ requires C, 83·9; H, 12·1%].

Cholest-4-en-3α-ol.—The above molecular compound (2·4 g.) in warm ethanol (200 c.c.) was treated with a warm solution of digitonin (8 g.) in 90% ethanol (750 c.c.), and the precipitate filtered off after 24 hr. The filtrate was evaporated in a vacuum, the residue extracted with ether, and the ethereal solution washed with water, dried, and evaporated. The product was crystallised from acetone to give, after 12 hr. at 0°, cholest-4-en-3α-ol (950 mg.), m. p. 83—84°, $[\alpha]_D$ +115° (*c* 0·8). Acetic anhydride–pyridine at 15° (15 hr.) furnished 3α-acetoxycholest-4-ene,[5,10] m. p. 82—83°, $[\alpha]_D$ +177° (*c* 1·0) [Found (after drying at 20°/0·03 mm. for 15 hr.): C, 81·4; H, 11·5. Calc. for $C_{29}H_{48}O_2$: C, 81·2; H, 11·3%], after recrystallisation from acetone.

3α-*Methoxycholest-4-ene.*—Attempted methylation of cholest-4-en-3α-ol (1 g.) with silver oxide–methyl iodide gave only cholesta-3 : 5-diene, m. p. and mixed m. p. 77—78°, $[\alpha]_D$ −90° (*c* 1·2), $\lambda_{max.}$ 235 mμ. Methanolysis of 3β-chlorocholest-4-ene {m. p. 75—76°, $[\alpha]_D$ −27° (*c* 1·0) to be described in a forthcoming paper} and recrystallisation of the product from acetone and acetone–methanol gave 3α-methoxycholest-4-ene, m. p. 45—46°, $[\alpha]_D$ +70° (*c* 1·0) (Found: C, 82·7; H, 11·85. Calc. for $C_{28}H_{48}O$: C, 83·9; H, 12·1%); this substance may be a 1 : 1 molecular compound of 3α- and 3β-methoxycholest-4-ene.

3β-*Anilinocholest-4-ene.*—3β-Chlorocholest-4-ene (m. p. 110°; 500 mg.) in ether (20 c.c.) was treated with freshly distilled aniline (5 c.c.) at 20° for 4 days. The mixture was poured into

[8] Shoppee, Richards, Sly, and Summers, *J.*, 1956, 1054.
[9] Plattner, Heusser, and Kulkarni, *Helv. Chim. Acta*, 1949, **32**, 265.
[10] Evans and Schoenheimer, *J. Amer. Chem. Soc.*, 1936, **58**, 182.

2N-hydrochloric acid, and the product isolated in the usual way and chromatographed on a column of aluminium oxide (15 g.) prepared in pentane. Elution with pentane (50 c.c.) gave an oil (50 mg.) which was rejected; further elution with pentane furnished 3β-*anilinocholest*-4-*ene* (200 mg.), m. p. 99—100°, $[\alpha]_D$ +22° (*c* 1·0), after recrystallisation from acetone–methanol [Found (after drying at 55°/0·03 mm. for 6 hr.): C, 85·7; H, 11·0. $C_{33}H_{51}N$ requires C, 85·9; H, 11·05%].

3β-*Anilinocholest*-5-*ene*.—Cholesteryl chloride (m. p. 95—96°; 1·42 g.) was refluxed with freshly distilled aniline (30 c.c.) for 45 min. The cooled mixture was poured into 2N-hydrochloric acid, then set aside for 0·5 hr., and the precipitate filtered off, washed with 2N-hydrochloric acid and with water, and dried. The product was chromatographed on aluminium oxide (45 g.) prepared in pentane; elution with pentane gave cholesteryl chloride (90 mg.), but elution with benzene afforded 3β-anilinocholest-5-ene [7] (1·1 g.), m. p. 188—189°, $[\alpha]_D$ −33° (*c* 1·35), after recrystallisation from benzene–acetone [Found (after drying at 20°/0·03 mm. for 24 hr.): C, 85·45; H, 11·0. Calc. for $C_{33}H_{51}N$: C, 85·9; H, 11·05%].

N-cyclo*Hexylcholestan*-3β-*ylamine*.—3β-Anilinocholest-5-ene (208 mg.) was hydrogenated with platinum oxide (100 mg.) in acetic acid (40 c.c.) in 0·5 hr. to give, after the usual isolation procedure, N-cyclo*hexylcholestan*-3β-*ylamine*, m. p. 140—141°, $[\alpha]_D$ +17° (*c* 1·15), after recrystallisation from benzene–acetone [Found (after drying at 95°/0·03 mm. for 6 hr.): C, 84·05; H, 12·6. $C_{33}H_{59}N$ requires C, 84·4; H, 12·6%].

N-*Benzylcholest*-4-*en*-3α- *and* -3β-*ylamine*.—3β-Chlorocholest-4-ene (1 g.) was refluxed with benzylamine (10 c.c.) for 2 hr. The cooled mixture was treated with excess of 2N-hydrochloric acid, and the insoluble hydrochlorides were filtered off and washed with water. The precipitate obtained by basification and extraction with ether gave, after working up, a yellow oil (1·2 g.) which failed to crystallise and was chromatographed on aluminium oxide (35 g.) prepared in pentane. Elution with pentane (3 × 60 c.c.) yielded an oil (175 mg.) which was discarded. Elution with benzene–pentane (1 : 9, and 1 : 4; 9 × 60 c.c.) gave N-*benzylcholest*-4-*en*-3α-*ylamine* (660 mg.), m. p. 68—70°, $[\alpha]_D$ +125° (*c* 1·0), after two recrystallisations from ethanol [Found (after drying at 20°/0·04 mm. for 24 hr.): C, 85·8; H, 11·2. $C_{34}H_{53}N$ requires C, 85·8; H, 11·2%]. Further elution with ether–benzene (1 : 9; 3 × 60 c.c.) gave N-*benzylcholest*-4-*en*-3β-*ylamine* (95 mg.), m. p. 76—78°, $[\alpha]_D$ +23° (*c* 1·0), after recrystallisation from acetone [Found (after drying at 18°/0·05 mm. for 8 hr.): C, 85·5; H, 11·2%].

Hydrogenations.—*Cholest*-4-*en*-3α-*ol*. (*a*) The 3α-alcohol (90 mg.; m. p. 83—84°, $[\alpha]_D$ +115°) by hydrogenation with platinum oxide (40 mg.) in ethyl acetate (30 c.c.) and chromatography on neutral aluminium oxide gave: (i) by elution with pentane (4 × 25 c.c.) an oil (15 mg.), which crystallised with difficulty from acetone to yield cholestane, m. p. and mixed m. p. 76°; (ii) by elution with benzene–pentane (1 : 4; 5 × 25 c.c.) an oil (13 mg.); (iii) by elution with ether–benzene (3 : 7; 5 × 25 c.c.) *epi*cholestanol (34 mg.), m. p. and mixed m. p. 183—185°, $[\alpha]_D$ +33° (*c* 1·1), after recrystallisation from ethanol, characterised as acetate, m. p. and mixed m. p. 94—95°; (iv) by further elution with ether–benzene (3 : 7; 4 × 25 c.c.) *epi*coprostanol (30 mg.), m. p. and mixed m. p. 110—112°, $[\alpha]_D$ +29° (*c* 0·44), after recrystallisation from acetone, characterised as acetate, m. p. and mixed m. p. 87—88°.

Similar experiments in the presence of (*b*) acetic acid (0·5 c.c.), (*c*) 10N-sulphuric acid (4 drops), and (*d*) 60% perchloric acid (3 drops) gave on chromatography as under (*a*): (*b*) cholestane (7 mg.), m. p. and mixed m. p. 75—78°, *epi*cholestanol (30 mg.), m. p. and mixed m. p. 181—183°, and *epi*coprostanol (52 mg.), m. p. and mixed m. p. 112—114°; (*c*) cholestane (+coprostane?) (75 mg.), m. p. 72—78°, *epi*cholestanol (4 mg.), m. p. ~180°, and *epi*coprostanol (16 mg.), m. p. and mixed m. p. 108—112°; (*d*) cholestane (+coprostane?) (85 mg.), m. p. and mixed m. p. 76—77° after crystallisation from acetone, and *epi*cholestanol (5 mg.), m. p. 180—182°.

Cholest-4-*en*-3α-*yl acetate*. (*a*) The acetate (m. p. 82—83°, $[\alpha]_D$ +177°; 90 mg.) by hydrogenation with platinum oxide (40 mg.) in ethyl acetate (30 c.c.) and chromatography on neutral aluminium oxide gave: (i) by elution with pentane (3 × 30 c.c.) an oil (32 mg.), which crystallised from acetone to give coprostane, m. p. and mixed m. p. 72—73°; (ii) by elution with benzene–pentane (1 : 9; 6 × 30 c.c.) *epi*coprostanyl acetate (43 mg.), m. p. 88°, mixed m. p. 86—88°, $[\alpha]_D$ +42° (*c* 0·5), characterised by hydrolysis with 5% methanolic potassium hydroxide to *epi*coprostanol, m. p. and mixed m. p. 112—113°.

Similar experiments in the presence of (*b*) acetic acid (0·5 c.c.), (*c*) 10N-sulphuric acid (3 drops), and (*d*) 60% perchloric acid (3 drops) gave by chromatography as under (*a*): (*b*) coprostane (28 mg.), m. p. and mixed m. p. 71—72°, and *epi*coprostanyl acetate (68 mg.), m. p. and

mixed m. p. 83—85°; (*c*) coprostane (62 mg.), m. p. and mixed m. p. 70—72°, and *epi*coprostanyl acetate (13 mg.), m. p. and mixed m. p. 84—85°; (*d*) coprostane (81 mg.), m. p. and mixed m. p. 70—72°, and *epi*coprostanyl acetate (7 mg.), m. p. 84°.

3α-*Methoxycholest*-4-*ene*. The ether (m. p. 45—46°, $[\alpha]_D$ +70°; 80 mg.) was hydrogenated with platinum oxide (40 mg.) in ethyl acetate (30 c.c.) to yield an oil (75 mg.) from which chromatography failed to yield crystalline fractions.

N-*Benzylcholest*-4-*en*-3α-*ylamine*. The base (100 mg.) was hydrogenated with platinum oxide (40 mg.) in acetic acid (uptake, 20 c.c.; calc. for $4H_2$, 19 c.c.) to give a solid, m. p. 83—102°, which was chromatographed on aluminium oxide (3 g.) prepared in pentane. Elution with pentane (6 × 30 c.c.) gave an oil (39 mg.), which by crystallisation from acetone gave *N*-(*cyclo*hexylmethyl)cholestan-3α-ylamine, m. p. 112—114°, $[\alpha]_D$ +20° (*c* 0·85), giving no depression with an authentic sample.[8] Elution with benzene–pentane (1 : 1; 3 × 30 c.c.) and with benzene (3 × 30 c.c.) furnished an oil (25 mg.), consisting of *N*-(*cyclo*hexylmethyl)coprostan-3α-ylamine, $[\alpha]_D$ +27° (*c* 1·2), characterised as the hydrochloride, m. p. 242—244°, identical with a genuine specimen.[8]

Cholest-4-*en*-3β-*ol*. (*a*) The 3β-alcohol (m. p. 132°, $[\alpha]_D$ +46°; 110 mg.) by hydrogenation with platinum oxide (60 mg.) in ethyl acetate (30 c.c.) and chromatography on neutral aluminium oxide gave: (i) by elution with pentane (4 × 25 c.c.) only traces of oil (3 mg.); (ii) by elution with ether–benzene (3 : 7; 3 × 25 c.c.), coprostanol (54 mg.), m. p. and mixed m. p. 100—101°, $[\alpha]_D$ +27·5° (*c* 1·1), after recrystallisation from methanol, characterised as acetate, m. p. and mixed m. p. 88—90°. Further elution with ether–benzene (3 : 7; 2 × 25 c.c. and 1 : 1; 3 × 25 c.c.) gave cholestanol (42 mg.), double m. p. 128°/142°, mixed m. p. 142°, $[\alpha]_D$ +28° (*c* 0·9), after recrystallisation from methanol, characterised as acetate, m. p. and mixed m. p. 108—109°.

Similar experiments in the presence of (*b*) acetic acid (0·5 c.c.), (*c*) 10N-sulphuric acid (3 drops), and (*d*) 60% perchloric acid (3 drops) gave by chromatography as under (*a*): (*b*) coprostanol (78 mg.), m. p. and mixed m. p. 98—100°, and cholestanol (14 mg.), m. p. and mixed m. p. 143°; (*c*) and (*d*) cholestane (90 mg.; 98 mg.), m. p. and mixed m. p. 76—78°, and traces of cholestanol (5 mg.; 3 mg.).

Cholest-4-*en*-3β-*yl acetate*. (*a*) The acetate (m. p. 88°, $[\alpha]_D$ +8°; 100 mg.) by hydrogenation with platinum oxide (60 mg.) in ethyl acetate and chromatography on neutral aluminium oxide gave: (i) by elution with pentane (2 × 30 c.c.) cholestane (37 mg.), m. p. and mixed m. p. 77—78°, after crystallisation from acetone; (ii) by elution with benzene–pentane (1 : 9; 5 × 30 c.c.) cholestanyl acetate (53 mg.), m. p. 108—109°, $[\alpha]_D$ +10·5° (*c* 0·8), after crystallisation from acetone, characterised by alkaline hydrolysis to cholestanol, double m. p. 128°/142°.

Similar experiments in the presence of (*b*) acetic acid (0·5 c.c.), (*c*) 10N-sulphuric acid (4 drops), and (*d*) 60% perchloric acid (3 drops) gave by chromatography: (*b*) cholestane (19 mg.), m. p. and mixed m. p. 78°, cholestanyl acetate (75 mg.), m. p. and mixed m. p. 109—110°, and cholestanol (6 mg.), double m. p. and mixed m. p. 128°/142°; (*c*) cholestane (75 mg.), m. p. 76—78°, cholestanyl acetate (7 mg.), m. p. 108°, and cholestanol (8 mg.), double m. p. 128°/142°; (*d*) cholestane (91 mg.), m. p. and mixed m. p. 78°, and cholestanyl acetate (8 mg.), m. p. and mixed m. p. 109—110°.

3β-*Methoxycholest*-4-*ene*. The ether (m. p. 71°, $[\alpha]_D$ +41°; 100 mg.) was hydrogenated with platinum oxide (60 mg.) in ethyl acetate (40 c.c.) and by chromatography on neutral aluminium oxide gave: (i) by elution with pentane (4 × 30 c.c.) cholestane (19 mg.), m. p. and mixed m. p. 76—78°, after recrystallisation from acetone; (ii) by elution with benzene–pentane (1 : 4; 2 × 30 c.c.) 3β-methoxycholestane (61 mg.), m. p. 83—84°, $[\alpha]_D$ +20° (*c* 0·9), undepressed by admixture with an authentic specimen prepared by methylation of cholestanol.[6]

Similar experiments in the presence of (*b*) acetic acid (0·5 c.c.), (*c*) 10N-sulphuric acid (3 drops), and (*d*) 60% perchloric acid (3 drops) all gave by chromatography as under (*a*): cholestane (35, 67, and 84 mg.), m. p. and mixed m. p. 76—78°, and 3β-methoxycholestane (60, 20, and 8 mg.), m. p. and mixed m. p. 83—84°.

3β-*Chlorocholest*-4-*ene*. The chloride (103 mg.) by hydrogenation with platinum oxide (65 mg.) in ethyl acetate gave an almost quantitative yield of cholestane, m. p. and mixed m. p. 78°, after filtration of a pentane solution over aluminium oxide and crystallisation from acetone.

3β-*Anilinocholest*-4-*ene*. The base (101 mg.) was hydrogenated with platinum oxide (50 mg.) in acetic acid (20 c.c.) to yield an oil (100 mg.), which was chromatographed on neutral aluminium oxide (6 g.) prepared in pentane. Elution with pentane (3 × 10 c.c.) gave cholestane,

m. p. and mixed m. p. 78° after crystallisation from acetone. Elution with ether–benzene (1 : 19; 6 × 10 c.c.) gave an uncrystallisable oil (38 mg.), but use of ether–benzene (1 : 3 and 1 : 1; 6 × 10 c.c.) and ether (3 × 10 c.c.) furnished *N-cyclo*hexylcholestan-3β-ylamine (49 mg.), m. p. and mixed m. p. 140—141° with the preparation described above, after recrystallisation from benzene–acetone.

Attempted Methylation of Cholest-4-en-3α-ol.—The 3α-alcohol (1 g.) and freshly precipitated silver oxide (1 g.) were refluxed with freshly distilled methyl iodide (15 c.c.) for 1·5 hr. The precipitate was filtered off and washed with ether, and the ethereal filtrate washed with sodium hydrogen sulphite solution, and with water, dried, and evaporated. The resultant oil crystallised when rubbed with acetone, to give a nearly quantitative yield of cholesta-3 : 5-diene, m. p. and mixed m. p. 77—78°, $[\alpha]_D$ +90° (*c* 1·2), $\lambda_{max.}$ 235 mμ.

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