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Further Aspects of the Wittig Reaction in the Steroid Series. 20-Dehydrocholesterol and 20-Isocholesterol

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The reaction between 21-nor-20-ketocholesteryl acetate (II) and triphenylphosphine-methylene has yielded 20-dehydrocholesteryl acetate (III). The catalytic hydrogenation of the latter in acetic acid over platinum produced cholestany. acetate (IV), whereas hydrogenation in ethanol over palladium–calcium carbonate gave 20-isocholesteryl acetate (Vb)l The reaction between steroidal diketones and triphenylphosphine-methylene has been studied. In the case of androstane-3,17-dione (VI), the main product was 3-methyleneandrostan-17-one (VII), while allopregnane-3,20-dione (X) and cholestane-3,6-dione (XII) yielded mainly the corresponding dimethylene compounds. Treatment of the diacetoxy-ketones Δ^5-androstene-3β,17β-diol-7-one diacetate (XIV) and androstane-3β,17β-diol-7-one diacetate (XVIIb) with triphenylphosphinemethylene led to the corresponding 7-methylene compounds XV and XVIIa, respectively, although only in moderate yield.

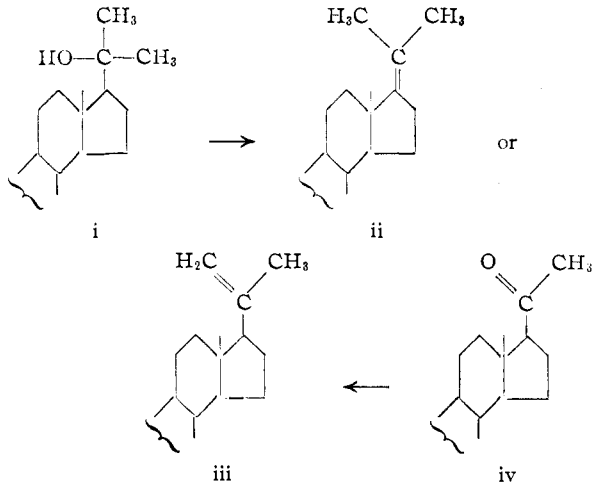
The methods available at present for the synthesis of substances containing the cholesterol side-chain from C_{20} and C_{21} steroids all involve the stereoisomeric 20-hydroxycholestanols as intermediates.[1] The latter on being dehydrated at C-20 with boiling acetic acid, acetylated at C-3 and then catalytically hydrogenated yield a mixture of cholestanyl acetate and what is presumably 20-iso-cholestanyl acetate from which the former has been isolated in poor yield.[1] The dehydration of 20ξ-hydroxycholestanol in principle could give five different olefins (two $\Delta^{17(20)}$-dehydrocholestanols, the corresponding $\Delta^{20(21)}$-isomer and two $\Delta^{20(22)}$-isomers),[2] although only a $\Delta^{17(20)}$-dehydrocholestanyl acetate has so far been obtained in the pure state (in 8% yield) from the reaction.[1b] We were interested in developing a better synthetic route to substances with the cholesterol side-chain and it seemed to us to be advantageous to use one pure dehydro-compound as an intermediate. We have reported previously on the application of the Wittig reaction in the steroid series.[3] In this paper we describe the synthesis of $\Delta^{5,20}$-cholestadien-3β-ol (20-dehydrocholesterol) acetate (III) by use of the Wittig reaction and the results of the hydrogenation of this substance. In addition certain other aspects of the Wittig reaction are reported, involving the condensation of triphenylphosphine-methylene with steroidal diketones and diacetoxy-ketones.

Reaction of the acid chloride I of 3β-acetoxy-Δ^5-etiocholenic acid with di-isohexylcadmium, as described previously,[1c] yielded the known 21-nor-20-ketocholesteryl acetate (II).[1c,4] This substance on being subjected to the Wittig reaction with triphenylphosphine-methylene and then re-acetylated, smoothly produced 20-dehydrocholesteryl acetate (III) provided a large excess of the reagent was used.[3] The structure of III follows from the elemental analysis and the presence in the infrared spectrum of bands at 1640 and 890 cm.$^{-1}$ characteristic of a terminal methylene group.[5]

The direction of hydrogenation of the Δ^{20}-double bond of III was found to depend on the conditions employed, although in no case was the reaction completely stereospecific. Thus, hydrogenation of III in acetic acid solution over a platinum catalyst caused both double bonds to be saturated and gave a mixture from which cholestanyl acetate (IV) could be isolated in *ca.* 25% yield. This represents a new way of constructing the cholesterol side-chain. On the other hand, hydrogenation of III in ethanol over a palladium–calcium carbonate catalyst effected the saturation only of the Δ^{20}-double bond; a mixture was produced, from which a substance was isolated in *ca.* 25% yield which was clearly different from cholesteryl acetate (melting point depression with an authentic sample). This new compound showed properties (m.p. 124–125°, $[\alpha]_D$ −52°) rather similar to those of cholesteryl acetate (m.p. 114–115°, $[\alpha]_D$ −45°) and it is clearly the C-20 epimer. This 20-isocholesteryl acetate was further characterized through saponi-

(1) (a) R. B. Woodward, F. Sondheimer, D. Taub, K. Heusler and W. M. McLamore, THIS JOURNAL, **74**, 4223 (1952); (b) H. M. E. Cardwell, J. W. Cornforth, S. R. Duff, H. Holtermann and R. Robinson, *J. Chem. Soc.*, 361 (1953); (c) P. Kurath and M. Capezzuto, THIS JOURNAL, **78**, 3527 (1956).

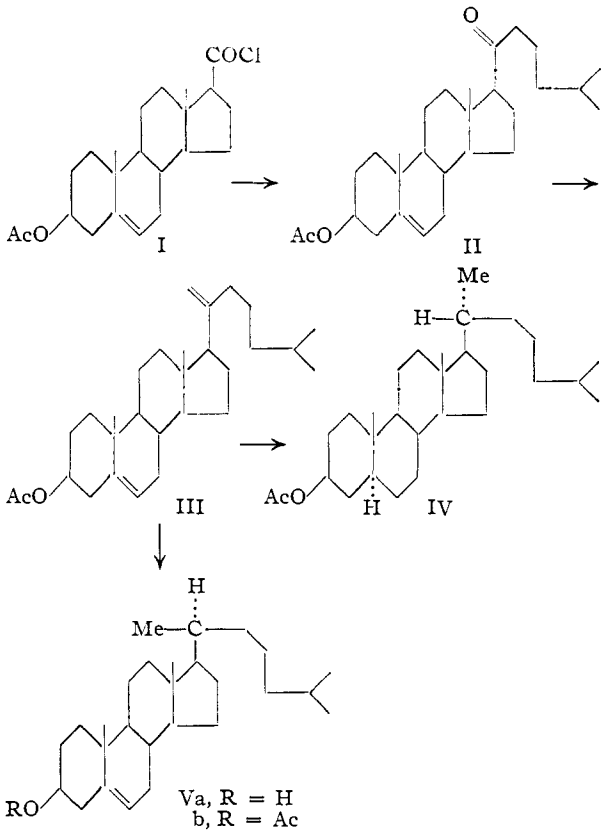
(2) *Cf.* A. Butenandt and H. Cobler, *Z. physiol. Chem.*, **234**, 218 (1935); A. Butenandt and G. Müller, *Ber.*, **71**, 191 (1938); B. Koechlin and T. Reichstein, *Helv. Chim. Acta*, **27**, 549 (1944). These workers have shown that the dehydration of 20-methylpregnan-20-ol derivatives (i) with boiling acetic acid may yield the $\Delta^{17(20)}$-olefin (ii) or the $\Delta^{20(21)}$-olefin (iii). We have found that the 20-methyleneallopregnan-3β-ol acetate (iii) obtained by the Swiss workers through dehydration of 20-methylallopregnane-3β,20-diol 3-acetate (i) was impure, by comparison of the reported physical properties with those found for an authentic sample prepared by us through subjecting allopregnan-3β-ol-20-one (iv) to the Wittig reaction with triphenylphosphine-methylene and acetylating the product (see Experimental).



(3) F. Sondheimer and R. Mechoulam, THIS JOURNAL, **79**, 5029 (1957).

(4) A. Wettstein, *Helv. Chim. Acta*, **23**, 1371 (1940).

(5) *Cf.* N. Sheppard and D. M. Simpson, *Quart. Revs. (London)*, **6**, 1 (1952), Table 7.



fication to free 20-isocholesterol.[5a] It previously has been shown[6] that the stereochemistry of the cholesterol side chain at C-20 is as represented in formula IV, *viz.*, that the 4′-methylpentyl grouping at C-20 is in the α-configuration according to Fieser's convention.[7] 20-Isocholesterol and its acetate therefore have the 4′-methylpentyl grouping at C-20 in the β-configuration and are to be represented by the formulas Va and Vb, respectively. 20-Isocholesterol and its acetate have a slightly more negative rotation than do cholesterol and its acetate, respectively. A similar small negative shift in rotation has been noted previously in passing from derivatives of the nor-cholanic acid to those of 20-iso-nor-cholanic acid.[8]

When the mother liquors obtained after removal of the crystalline 20-isocholesteryl acetate were hydrogenated in acetic acid over platinum in order to saturate the Δ^5-double bond, a C-20 stereoisomeric mixture was obtained from which no cholestanyl acetate (IV) could be isolated. This experiment shows that the two hydrogenation conditions had indeed given different proportions of cholesterol and 20-isocholesterol derivatives and that the isolation of substances with opposing configurations at C-20 is not due to the preferred crystallization or solubility properties of cholestanyl acetate in one case and of 20-isocholesteryl acetate in the other.

In the previous paper[3] on the application of the Wittig reaction in the steroid series, we reported on the reaction of triphenylphosphine-methylene with steroidal monoketones and hydroxy-ketones. We have now extended the reaction to include steroidal diketones and diacetoxy-ketones. Of the diketones, the first example studied was androstane-3,17-dione (VI), which was allowed to react with 6 molar equivalents of triphenylphosphine-methylene first at room temperature in ether and then in boiling tetrahydrofuran, as previously.[3] Rather surprisingly, this reaction gave the expected product, 3,17-dimethyleneandrostane (VIII), in only 10% yield. The major product, obtained in 55% yield, was 3-methyleneandrostan-17-one (VII). The structure of this substance was confirmed by its infrared spectrum [ν_{max} 1740 cm.$^{-1}$ (five-membered cyclic ketone), 1647 and 889 cm.$^{-1}$ (terminal methylene)] and through lithium aluminum hydride reduction to 3-methyleneandrostan-17β-ol (IXa), identical with the compound obtained previously[3] from androstan-17β-ol-3-one (IXb) and triphenylphosphine-methylene. The differential reaction doubtless is due to the insolubility of the intermediate complex. As in other reactions (*cf.* the preferential reduction of androstane-3,17-dione with sodium borohydride[9]), the carbonyl group at C-3 was more reactive than at C-17. As expected, 3-methyleneandrostan-17-one (VII) after being isolated reacted smoothly with triphenylphosphine-methylene and yielded 3,17-dimethyleneandrostane (VIII) in 76% yield.

This differential reaction of a diketone is not general, since allopregnane-3,20-dione (X) with excess triphenylphosphine-methylene gave 3,20-dimethyleneallopregnane (XI) in 75% yield and cholestane-3,6-dione (XII) gave 51% of 3,6-dimethylenecholestane (XIII). The last-mentioned reaction in addition yielded 5% of a monomethylenecholestanone, but whether it was 3-methylenecholestan-6-one or 6-methylenecholestan-3-one was not determined.

Two steroidal dihydroxy-ketones (as the diacetates) were subjected to the reaction with triphenylphosphine-methylene. The Δ^5-androstene-3β,17β-diol-7-one diacetate (XIV)[10] with 6 molar equivalents of the reagent and subsequent reacetylation gave 7-methylene-Δ^5-androstene-3β,17β-diol diacetate (XV), but only in 26% yield. In addition there was obtained 33% of $\Delta^{3,5}$-androstadien-17β-ol-7-one acetate (XVI),[10a] derived from XIV by loss of acetic acid. Under similar conditions, androstane-3β,17β-diol-7-one diacetate (XVIIb)[10b] gave only 17% of 7-methyleneandrostane-3β,17β-diol diacetate (XVIIa). It has been noted already that steroidal monohydroxy- or monoacetoxy-ketones in the Wittig reaction give lower yields of methylene compounds than do

(5a) ADDED IN PROOF.—K. Tsuda, R. Hayatsu, Y. Kishida and S. Akagi (THIS JOURNAL, **80**, 921 (1958)) have now described the degradation of the natural sterol sargasterol to 20-isocholesterol and reported that an attempted synthesis of the latter was unsuccessful.

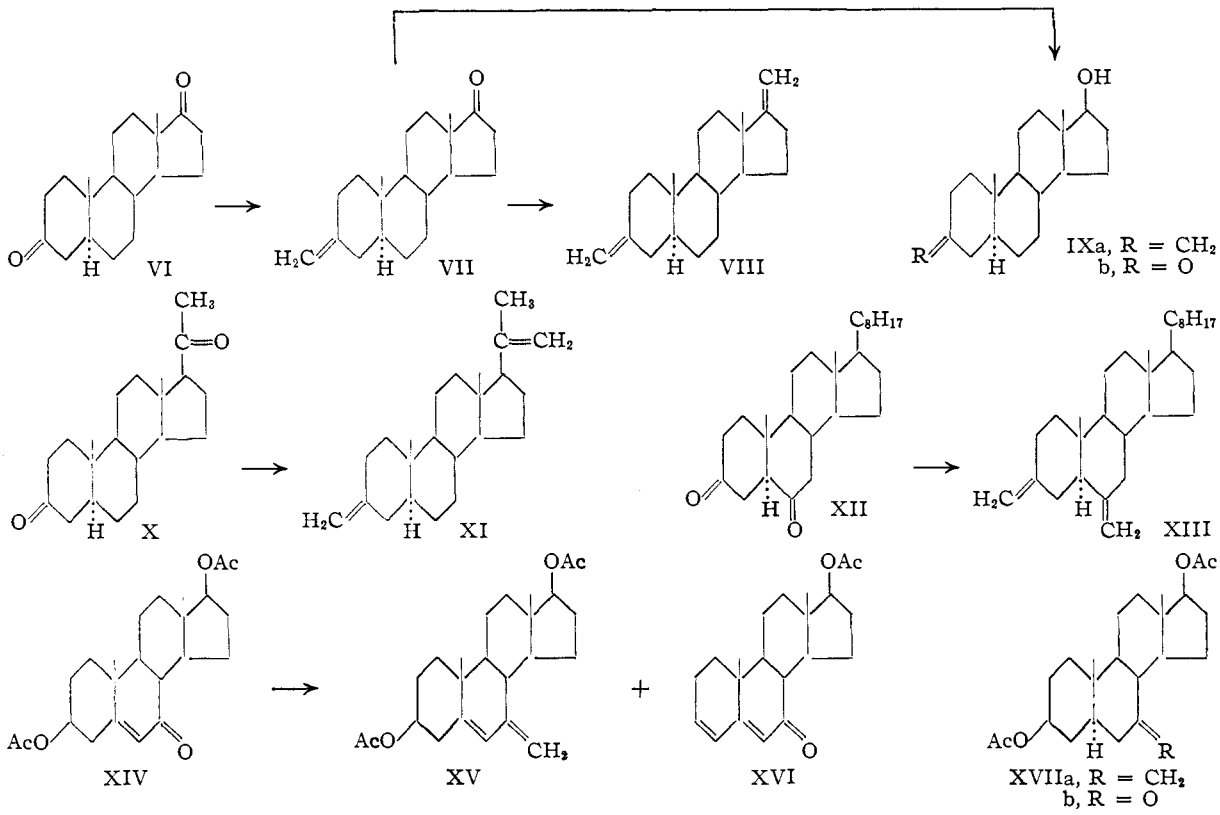
(6) C. H. Carlisle and D. Crowfoot, *Proc. Roy. Soc.* (*London*), **A184**, 64 (1945); P. Wieland and K. Miescher, *Helv. Chim. Acta*, **32**, 1922 (1949); W. Klyne, *Chemistry & Industry*, 426 (1951); B. Riniker, D. Arigoni and O. Jeger, *Helv. Chim. Acta*, **37**, 546 (1954).

(7) L. F. Fieser and M. Fieser, *Experientia*, **4**, 285 (1948); "Natural Products Related to Phenanthrene," 3rd edition, Reinhold Publishing Corp., New York, N. Y., 1949, pp. 412–419.

(8) P. A. Plattner and J. Pataki, *Helv. Chim. Acta*, **26**, 1241 (1943).

(9) E. Elisberg, H. Vanderhaeghe and T. F. Gallagher, THIS JOURNAL, **74**, 2814 (1952).

(10) (a) A. Butenandt, E. Hausmann and J. Paland, *Ber.*, **71**, 1316 (1938); (b) K. Heusler and A. Wettstein, *Helv. Chim. Acta*, **35**, 284 (1952).



simple ketones and this trend persists in the case of the two diacetoxy-ketones studied.

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Experimental[11]

21-Nor-20-ketocholesteryl acetate (II) was prepared from 3β-acetoxy-Δ^5-etiocholenic acid chloride (I) and di-isohexylcadmium as described by Kurath and Capezzuto.[10] The material obtained in *ca.* 50% yield showed m.p. 136–140°, $[\alpha]_D$ +13°; reported[10] for the analytical sample m.p. 140–142°, $[\alpha]_D$ +11°.

$\Delta^{5,20}$-Cholestadien-3β-ol Acetate (20-Dehydrocholesteryl Acetate) (III).—A 1 *N* ethereal solution of butyllithium (9 cc.) was added to a suspension of 3.5 g. of methyltriphenylphosphonium bromide[12] in 50 cc. of ether with swirling, under nitrogen. The mixture was stirred in nitrogen for 2 hr. and a solution of 0.7 g. of the keto-ester II in 50 cc. of ether was then added dropwise during 15 minutes. The mixture was stirred for another 4 hr. and allowed to stand overnight at room temperature. Tetrahydrofuran was then added at the same time as the ether was distilled off until most of the latter had been replaced. The mixture was boiled under reflux for 6 hr., cooled and diluted with ether and water. The organic layer was washed with water, dilute hydrochloric acid and sodium bicarbonate solution. It was then dried and evaporated and the residue was re-acetylated by being allowed to stand overnight with 16 cc. of pyridine and 8 cc. of acetic anhydride. Isolation with ether in the usual way led to a product which was chromatographed on 100 g. of alumina (Merck). Crystallization of the fractions eluted with petroleum ether–benzene (4:1) from methanol gave 0.38 g. (54%) of the acetate III with m.p. 95–98°. The analytical sample was obtained by further crystallization from methanol and showed m.p. 100–101°, $[\alpha]_D$ −48°; ν_{max} 1730, 1640 and 890 cm.$^{-1}$.

Anal. Calcd. for $C_{29}H_{46}O_2$: C, 81.63; H, 10.87. Found: C, 81.24; H, 10.65.

Cholestanyl Acetate (IV) from 20-Dehydrocholesteryl Acetate (III).—A solution containing 300 mg. of the acetate III in 30 cc. of glacial acetic acid was shaken in hydrogen over 50 mg. of a prereduced platinum catalyst. Two equivalents of hydrogen was absorbed in *ca.* 15 minutes and uptake stopped. The catalyst was removed, most of the solvent was evaporated under reduced pressure, ether and water were added to the residue and the organic layer was washed with sodium carbonate solution and water. The ether extract was then dried and evaporated. The residue by direct crystallization from ethanol and chromatography of the mother liquors on alumina (Alcoa) gave a total of 76 mg. (25%) of cholestanyl acetate, m.p. 105–108°. A further purified sample showed m.p. 110–111°, $[\alpha]_D$ +12°. There was no depression in m.p. on admixture with an authentic sample (m.p. 110–111°, $[\alpha]_D$ +13°) and the infrared spectra were identical.

20-Isocholesteryl Acetate (Vb) from 20-Dehydrocholesteryl Acetate (III).—A solution containing 550 mg. of the acetate III in 50 cc. of absolute ethanol was shaken in hydrogen over 80 mg. of a 5% palladium–calcium carbonate catalyst. After 30 minutes exactly 1 equivalent of hydrogen had been taken up and absorption stopped. The catalyst was removed by filtration and the solvent was evaporated. The semi-solid residue on crystallization from ethanol gave 190 mg. of crystals, m.p. 95–102° which on further crystallization from methanol gave 92 mg. of 20-isocholesteryl acetate (Vb) with m.p. 115–117°. Chromatography of the mother liquors on 25 g. of alumina (Alcoa) gave fractions eluted with petroleum ether which on crystallization from methanol produced a further 41 mg. of Vb, m.p. 114–116° (total yield 24%). The analytical sample, obtained by further crystallization from methanol, showed m.p. 124–125°, $[\alpha]_D$ −52°, ν_{max} 1724 cm.$^{-1}$. There was a considerable m.p. depression on admixture with an authentic sample of cholesteryl acetate (m.p. 114–115°, $[\alpha]_D$ −45°), despite the

(11) Melting points are uncorrected. Rotations were determined at 20–25° in chloroform solution. Ultraviolet spectra were measured on a Unicam model S.P. 500 spectrophotometer and infrared spectra in chloroform solution on a Perkin–Elmer model 12 C single beam spectrophotometer with sodium chloride prism. The chromatograms were made either with Alcoa activated alumina, grade F-20 (Aluminum Co. of American, Pittsburgh, Pa.) or with Merck acid-washed alumina, as indicated. Analyses were carried out in our microanalytical department under the direction of Mr. Erich Meier.

(12) G. Wittig and U. Schöllkopf, *Ber.*, **87**, 1318 (1954).

fact that the infrared spectra were almost indistinguishable.

Anal. Calcd. for $C_{29}H_{48}O_2$: C, 81.25; H, 11.29. Found: C, 81.41; H, 11.50.

The mother liquors after removal of the crystalline 20-isocholesteryl acetate on being fully hydrogenated in acetic acid solution over a platinum catalyst gave a saturated product from which no cholestanyl acetate could be separated either by direct crystallization or by chromatography.

20-Isocholesterol (Va) was obtained by boiling 40 mg. of the acetate Vb with 200 mg. of potassium hydroxide, 0.5 cc. of water and 8 cc. of methanol for 1 hr. Isolation with ether and crystallization from aqueous ethanol gave the analytical sample with m.p. 152–154°, $[\alpha]_D$ −42°. The infrared spectrum was almost identical with that of a sample of cholesterol (m.p. 149–150°, $[\alpha]_D$ −39°), although the m.p. was depressed to 120–125° on admixture.

Anal. Calcd. for $C_{27}H_{46}O$: C, 83.87; H, 11.99. Found: C, 83.58; H, 11.82.

3-Methylene-androstan-17-one (VII) and 3,17-Dimethyleneandrostane (VIII) from Androstane-3,17-dione (VI).—The reaction between 900 mg. of androstane-3,17-dione and triphenylphosphine-methylene was carried out as described above for the preparation of III, 6 molar equivalents of reagent being employed. The product was chromatographed on 100 g. of alumina (Alcoa). Elution with petroleum ether–benzene (4:1) gave 89 mg. (10%) of the dimethylene compound VIII, m.p. 98–102°. Crystallization from methanol gave the analytical sample, m.p. 104–104.5°, $[\alpha]_D$ +24°; ν_{max} 1650 and 890 cm.$^{-1}$, no bands in the 1700–1740 cm.$^{-1}$ region.

Anal. Calcd. for $C_{21}H_{32}$: C, 88.66; H, 11.34. Found: C, 88.59; H, 11.25.

Further elution with petroleum ether–benzene (2:1 and 1:1) gave a solid which on crystallization from methanol furnished 495 mg. (55%) of the monomethylene ketone VII, m.p. 143–145°. The analytical sample showed m.p. 145.5–146.5°, $[\alpha]_D$ +91°; ν_{max} 1740, 1647 and 889 cm.$^{-1}$.

Anal. Calcd. for $C_{20}H_{30}O$: C, 83.86; H, 10.56. Found: C, 83.47; H, 10.56.

3,17-Dimethyleneandrostane (VIII) from 3-Methyleneandrostan-17-one (VII).—3-Methyleneandrostan-17-one (VII) (600 mg.) was allowed to react with 5 molar equivalents of triphenylphosphine-methylene, as previously. Chromatography of the product on 60 g. of alumina (Alcoa) and elution with petroleum ether–benzene (4:1) gave 452 mg. (76%) of the dimethylene compound VIII, m.p. 90–95°. Crystallization from methanol yielded 372 mg. of material with m.p. 103–104°, undepressed on admixture with the sample obtained in the previous experiment. Further proof of identity was obtained by comparison of the infrared spectra.

3-Methyleneandrostan-17β-ol (IXa) from 3-Methyleneandrostan-17-one (VII).—3-Methyleneandrostan-17-one (VII) (160 mg.) dissolved in 10 cc. of ether was added to 200 mg. of lithium aluminum hydride in 20 cc. of ether and the mixture was boiled for 30 minutes. Decomposition with ethyl acetate and isolation in the usual way, followed by crystallization from methanol, gave 132 mg. of 3-methyleneandrostan-17β-ol (IXa) with m.p. 149–150°. Identity with the previously described IXa[3] of m.p. 149–150° was established by mixture m.p. determination and infrared comparison.

3,20-Dimethyleneallopregnane (XI) from Allopregnane-3,20-dione (X).—Allopregnane-3,20-dione (X) (940 mg.) was allowed to react with 5 molar equivalents of triphenylphosphine-methylene, as previously. Chromatography of the product on 100 g. of alumina (Alcoa) and elution with petroleum ether–benzene (2:1) yielded 695 mg. (75%) of the dimethylene compound XI with m.p. 93–96°. The analytical sample, obtained by crystallization from methanol, showed m.p. 97.5–98.5°, $[\alpha]_D$ +11°; ν_{max} 1640 and 888 cm.$^{-1}$, no band at *ca.* 1700 cm.$^{-1}$.

Anal Calcd. for $C_{23}H_{36}$: C, 88.39; H, 11.61. Found: C, 88.69; H, 11.37.

3,6-Dimethylenecholestane (XIII) from Cholestane-3,6-dione (XII).—The Wittig reaction was carried out with 1.6 g. of cholestane-3,6-dione (XII) and 6 molar equivalents of triphenylphosphine-methylene, as usual. Chromatography of the product on 150 g. of alumina (Alcoa), elution with petroleum ether–benzene (3:1) and crystallization from acetone–methanol gave 805 mg. (51%) of 3,6-dimethylenecholestane (XIII), m.p. 84.5–86.5°. Further crystallization from this solvent pair led to the analytical specimen, m.p. 87–88°, $[\alpha]_D$ −7°; ν_{max} 1640 and 886 cm.$^{-1}$, no band at *ca.* 1700 cm.$^{-1}$.

Anal. Calcd. for $C_{29}H_{48}$: C, 87.80; H, 12.20. Found: C, 87.42; H, 12.40.

Further elution of the column with petroleum ether–benzene (1:1) and crystallization from acetone–methanol furnished 84 mg. (5%) of a substance with m.p. 85–88°, giving a large depression on admixture with XIII. A further purified sample showed m.p. 95–97°, $[\alpha]_D$ −13°; ν_{max} 1706, 1650 and 890 cm.$^{-1}$. It is probably either 3-methylenecholestan-6-one or 6-methylenecholestan-3-one.

7-Methylene-Δ⁵-androstene-3β,17β-diol Diacetate (XV) and Δ³,⁵-Androstadien-17β-ol-7-one Acetate (XVI) from Δ⁵-Androstene-3β,17β-diol-7-one Diacetate (XIV).—The reaction was carried out between 1.2 g. of the diacetoxy-ketone XIV[10] and 6 molar equivalents of triphenylphosphine-methylene, as usual. The total product was re-acetylated by being allowed to stand overnight with 15 cc. of acetic anhydride and 30 cc. of pyridine. The acetylated material was isolated with ether and chromatographed on 150 g. of alumina (Alcoa). Elution with petroleum ether–benzene (1:1) yielded 700 mg. of an oily product which was re-chromatographed on 50 g. of alumina. Petroleum ether–benzene (2:1 and 1:1) eluted an oil which partially solidified. Crystallization from methanol furnished 310 mg. (26%) of the methylene compound XV with m.p. 119–122°. The analytical specimen showed m.p. 126–127°, $[\alpha]_D$ −217°, λ_{max} 237 mμ (log ε 4.35) (isooctane); ν_{max} 1725, 1655 and 895 cm.$^{-1}$.

Anal. Calcd. for $C_{24}H_{34}O_4$: C, 74.57; H, 8.87. Found: C, 74.21; H, 8.62.

Elution of the first chromatogram with petroleum ether–benzene (1:2) and then crystallization from methanol yielded 340 mg. (33%) of Δ³,⁵-androstadien-17β-ol-7-one acetate (XVI), m.p. 223–224°, $[\alpha]_D$ −396°, λ_{max} 280 mμ (log ε 4.42) (ethanol); reported[10a] m.p. 222°, $[\alpha]_D$ −400°.

7-Methyleneandrostane-3β,17β-diol Diacetate (XVIIa) from Androstane-3β,17β-diol-7-one Diacetate (XVIIb).—Androstane-3β,17β-diol-7-one diacetate (XVIIb)[10b] (600 mg.) was allowed to react with 6 molar equivalents of triphenylphosphine-methylene, as usual. The product was re-acetylated as in the preceding experiment and then chromatographed on 30 g. of alumina (Alcoa). The oily fractions (310 mg.) eluted with petroleum ether–benzene (1:1) were rechromatographed on 30 g. of alumina. Elution with petroleum ether–benzene (7:3) followed by crystallization from methanol produced 104 mg. (17%) of the methylene compound XVIIa with m.p. 110–112°. Further crystallization from methanol gave the analytical sample, double m.p. 115–116° and 132.5–134.5°, $[\alpha]_D$ −41°; ν_{max} 1725, 1640 and 886 cm.$^{-1}$.

Anal. Calcd. for $C_{24}H_{36}O_4$: C, 74.19; H, 9.34. Found: C, 73.81; H, 9.56.

20-Methyleneallopregnan-3β-ol (iii) from Allopregnan-3β-ol-20-one (iv).—The Wittig reaction was carried out between 960 mg. of allopregnan-3β-ol-20-one (iv) and 3 molar equivalents of triphenylphosphine-methylene, as usual. Chromatography of the product on 120 g. of alumina (Alcoa), elution with benzene–ether (2:1) and crystallization from petroleum ether gave 530 mg. (55%) of 20-methyleneallopregnan-3β-ol with m.p. 143–147°. The analytical sample showed m.p. 149.5–150.5°, $[\alpha]_D$ +15°; ν_{max} 3475, 1640 and 890 cm.$^{-1}$; reported by Koechlin and Reichstein[2] m.p. 165° (change of phase at 130–140°).

Anal. Calcd. for $C_{22}H_{36}O$: C, 83.48; H, 11.47. Found: C, 83.49; H, 11.46.

The acetate after crystallization from methanol showed m.p. 123–124°, $[\alpha]_D$ +2°; ν_{max} 1720, 1640 and 886 cm.$^{-1}$; reported by Koechlin and Reichstein[2] m.p. 111–114°, $[\alpha]_D$ 0°.

Anal. Calcd. for $C_{24}H_{38}O_2$: C, 80.39; H, 10.68. Found: C, 80.17; H, 10.43.

REHOVOTH, ISRAEL