1.47, 1.70; inflections 364, 358, 340, 315 mμ, log ε 0.97, 1.17, 1.60, 1.78; from Syntex, S.A. R.D. (Fig. 5): "max." $[\alpha]_{312.5}$ + 3786°; c = 0.10; temp. 23–24°.[11]

Pregnane-3β-ol-20-one (XVII), m.p. 144–146°; λ_{max} 238–291 mμ, log ε 1.53; supplied by Syntex, S.A. R.D. (Fig. 5): $[\alpha]_{700}$ + 55°, $[\alpha]_{589}$ +85°, $[\alpha]_{295}$ +601°, "max." $[\alpha]_{312.5}$ + 2393°; c = 0.10; temp. 25°.[11]

Etiocholane-3α,17β-diol-11-one (XVIII), m.p. 261–262°; λ_{max} 302–303 mμ, log ε 1.51, shoulders 311–313, 292–294 mμ, log ε 1.46, 1.46; inflections 320, 325 mμ, log ε 1.28, 1.16; supplied by Dr. E. B. Hershberg and Dr. H. L. Herzog, Schering Corp. R.D. (Fig. 5): $[\alpha]_{700}$ +39°, $[\alpha]_{589}$ +59°, $[\alpha]_{300}$ +53°, "max." $[\alpha]_{327.5}$ +679°; c = 0.10; temp. 24°.[11]

DETROIT, MICHIGAN

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY OF WAYNE UNIVERSITY]

Optical Rotatory Dispersion Studies. III.[1] The Cholestane Series[2]

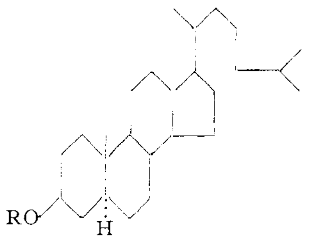
BY A. E. LIPPMAN, ELEANOR W. FOLTZ AND CARL DJERASSI

RECEIVED MARCH 16, 1955

The rotatory dispersion curves of various isomeric cholestenols and ketones of the cholestane series are reported and discussed. Some of the mathematical implications are also presented.

Cholesterol (V) is one of the very few steroids, the rotatory dispersion of which has been examined prior to our own investigations[1,3] in this field and initial measurements with this substance in the visible region have been carried out as early as 1863.[4a] We now have measured the rotatory dispersion of various members of the cholestane series and in particular of various double bond isomers of cholesterol. These substances, lacking strong chromophores such as carbonyl groups, should show "normal" dispersion curves and hence should be more amenable to mathematical treatment. We also have included several ketones of the cholestane series in order to complement the earlier studies[1,3] of the rotatory dispersion of carbonyl-containing steroids.

The dispersion curves of the ketones studied in this series are shown in Fig. 2 and the results fully confirm the earlier conclusions.[1,3] Cholestan-3-one (IX) is very similar to androstan-3-one, discussed previously,[3] in that it shows the positive rotation peak at 315 mμ ascribed to a weakly asymmetric chromophore associated with the carbonyl function at C-3; furthermore, this substance shows the negligible effect that the cholestane side chain appears to have on the rotation of the molecule.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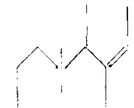
II, R = CH_3CO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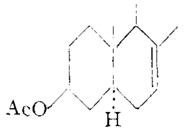
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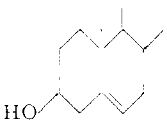
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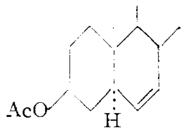
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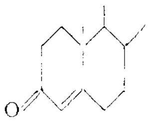
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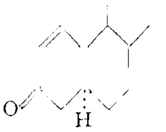
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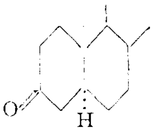
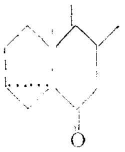
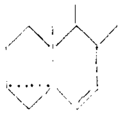

IX


X


XI

Considering the region 350–400 mμ, so important for unsaturated ketones,[1,3] Δ^4-cholesten-3-one (VII) exhibits a "maximum"[5] at 360 mμ and "minima" at 365 and 350 mμ, corresponding to an optically active absorption band at 355 mμ (mean of positive peak at 360 mμ and negative peak at 350 mμ). While the position of this band (and the peaks defining it) is in accord with that of other Δ^4-3-keto steroids,[1,3] it is noteworthy that these two peaks occur at a negative rotation. The only other Δ^4-3-ketone exhibiting such a behavior is testosterone[1] and these two compounds are the only Δ^4-3-keto steroids in our series[1,3] which do not have an additional saturated carbonyl group elsewhere in the molecule. Another typical property of these two unsaturated ketones is that the "minimum" at 365 mμ occurs at a more positive rotation than the "minimum" at 350 mμ and both these features can be considered as the true characteristics of the Δ^4-3-keto dispersion curve. In all the other Δ^4-3-ketosteroids,[1,3] this order is reversed and this clearly is due to the fact that in those instances the Δ^4-3-keto band is coming under the influence of the very much stronger and highly positive band (in the 320 mμ region) corresponding to the additional saturated carbonyl group (at C-11, 17 or 20) which tends to "pull up" this part of the curve to more positive rotation values. It should be emphasized, however, that this does not interfere with the recognition of the Δ^4-3-keto moiety through its rotatory dispersion band, but rather offers a further refinement of this method through a consideration of both *position* and *relative intensity* of "maxima" and "minima."

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(1) Paper II, E. W. Foltz, A. E. Lippman and C. Djerassi, THIS JOURNAL, **77**, 4359 (1955).

(2) Supported by a grant from the National Science Foundation.

(3) C. Djerassi, E. W. Foltz and A. E. Lippman, THIS JOURNAL, **77**, 4354 (1955).

(4) (a) O. Lindenmayer, *J. prakt. Chem.*, [1] **90**, 323 (1863); (b) L. Tschugaeff, *Z. physik. Chem.*, **76**, 469 (1911). (c) Cholesterol has been measured over the range 260–750 mμ by E. Brand, E. Washburn, B. F. Erlanger, E. Ellenbogen, J. Daniel, F. Lippmann and M. Scheu, THIS JOURNAL, **76**, 5037 (1954).

(5) See ref. 3 for a definition of terms and general experimental procedure.

The "maxima" and "minima" for Δ^1-cholesten-3-one (VIII) corresponding to an optically active absorption band at 377 mμ are in excellent agreement with the values noted for Δ^1-androstene-3,17-dione,[3] the only difference being the pull to positive rotation values in the latter compound due to the strongly positive C-17 keto band. Again, it should be noted that one of the characteristic features of the Δ^1-3-keto (unaccompanied by other carbonyl groups) curve in the 350–400 mμ region is the negative rotation.

Another important region, noticeable in these two unsaturated ketones, is that below 320 mμ, which in all preceding cases[1,3] (with the exception of testosterone[1]) was completely overshadowed by the sharp peaks due to the additional unconjugated carbonyl substituents. In the present instance, this region is characterized by distinctly flat peaks of rotation, both the position and intensity differing greatly between the two types (VII and VIII). Whether or not this is due to passage of the dispersion curve through an optically active absorption band cannot be decided until experimental measurements can be extended further into the ultraviolet. The relative flatness of the peaks would tend to indicate that this is not the case even though no reasonable alternative explanation can be offered at the present time. It is clear that this peak must somehow be associated with the presence of the conjugated system in the molecule since it hardly could be ascribed to the isolated Δ^4- and Δ^1-double bonds in the light of our results (see below) with various double bond isomers of cholesterol.

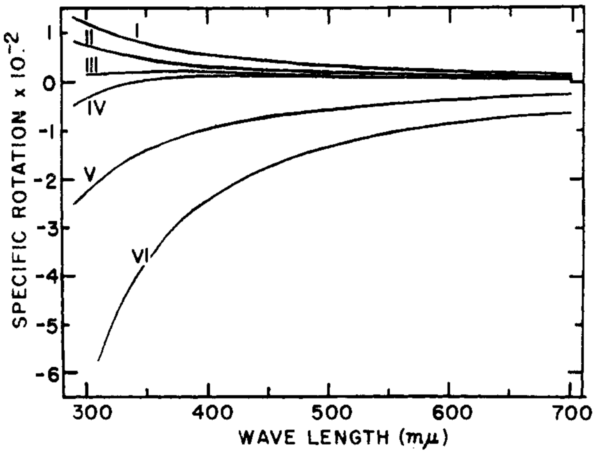

Fig. 1.—Rotatory dispersion curves of: cholestan-3β-ol (I), cholestan-3β-ol acetate (II), $\Delta^{8(14)}$-cholesten-3β-ol acetate (III), Δ^7-cholestan-3β-ol acetate (IV), cholesterol (V) and Δ^6-cholesten-3β-ol acetate (VI).

Examination of the dispersion curves (Fig. 1) of the four isomeric cholesten-3-ols and/or acetates (III–VI) would indicate that the Δ^6-(VI), Δ^5-(V), Δ^7-(IV) and $\Delta^{8(14)}$-(III) double bonds are responsible for a negative rotation contribution (decreasing in that order) when compared with the saturated cholestan-3β-ol (I). In the case of Δ^6-cholesten-3β-ol acetate (VI) this is in agreement with our results on 6-dehydroestradiol,[1] though in that example the C-17 hydroxyl group also may have contributed to the negative rotation.[6] It appears possible that the introduction of such a double bond gives rise to a new, optically active absorption band situated further in the ultraviolet and which causes negative rotation at its long wave length side. This would account for the increasing negative rotation with decreasing wave length observed with the Δ^5-(V), Δ^6-(VI) and Δ^7-(IV) but not $\Delta^{8(14)}$-(III) cholesten-3β-ols. Acetylation does not seem to modify to an appreciable extent the shape of the dispersion curve, as demonstrated by the curves of cholestan-3β-ol (I) and its acetate (II), other than causing a slight shift toward the negative.

Two 3,5-cyclo-steroids (X, XI), available in this Laboratory, also were included in this study (Fig. 2). The negative rotation peak at 317.5 mμ exhibited by 3,5-cyclocholestan-6-one (X), is almost exactly symmetrical about the wave length axis with the corresponding feature in cholestan-3-one. This undoubtedly represents the passage of the dispersion curve through an optically active absorption band associated with the carbonyl function at C-6, which thus differs from that at C-3 only by causing a negative rotation on its long wave length side. This was confirmed recently (to be published) when as part of a detailed study of the effect of isolated carbonyl groups in the steroid series, cholestan-3β-ol-6-one was measured and its dispersion spectrum proved to have a shape very similar to that of the ketone X.

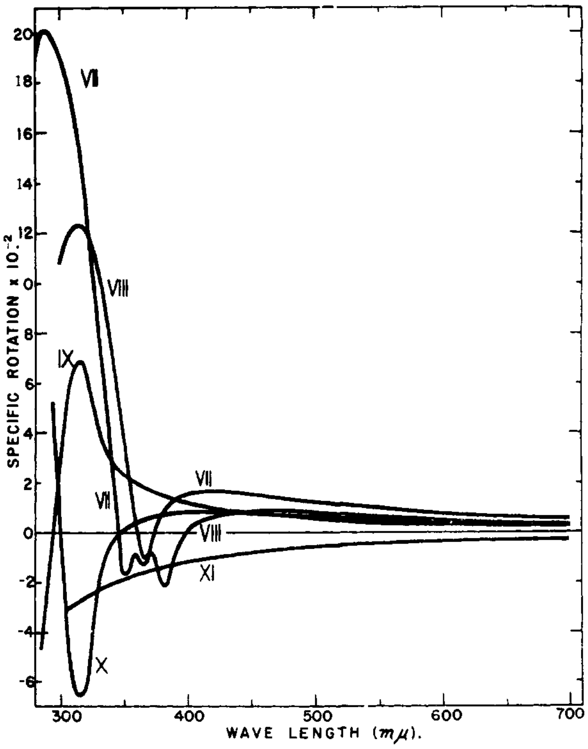

Fig. 2.—Rotatory dispersion curves of: Δ^4-cholesten-3-one (VII), Δ^1-cholesten-3-one (VIII), cholestan-3-one (IX), 3,5-cyclocholestan-6-one (X) and 3,5-cyclo-Δ^6-cholestene (XI).

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[6] The slight negative contribution of the Δ^7-double bond was not observed with equilin (ref. 1) because there it was obviously obscured by the large positive effect of the 17-keto function.

Mathematical Results

Our original purpose in computing Drude equations for all compounds was twofold. (a) It was hoped to correlate the calculated values of λ_0 with the position of the absorption bands in the ultraviolet. (b) It was expected that the constant K[7] would lend itself better to the calculation of molecular rotation differences than values obtained from rotations measured at the sodium D line. As shown in the preceding two papers[1,3] and in the discussion following immediately below, it has been possible to a certain extent to correlate λ_0 values with absorption bands, but we do not consider the values obtained for the other two constants of the Drude equations sufficiently unambiguous to make them the basis for calculations of molecular rotation differences. In the light of these considerations we have decided to limit ourselves in future work to accurate determinations of the shapes of rotatory dispersion curves without attempting to fit equations to our results.

Of the eleven compounds in this series, only the results for Δ^1-cholesten-3-one (VIII) could not be fitted to a Drude equation, but the equation for the Δ^4-isomer (VII) hardly can be credited with much significance because of the abnormally low λ_0 value (173 mμ) calculated from it. In the light of our current ideas[1,3] about the optical activity of the intense band due to the conjugated keto group, this λ_0 value should fall near 240 mμ. It should be noted that this equation does not express the experimental results satisfactorily at wave lengths below 475 mμ. The λ_0 value of 311 mμ calculated for cholestan-3-one (IX) is in excellent agreement with that (314 mμ) obtained for androstan-3-one[3] and falls near the observed absorption region (284–292 mμ) for saturated 3-ketosteroids.

Cholestan-3β-ol (I) is another substance[1,3] to which both a one-term and two-term equation could be fitted. The increase in the λ_0 value from 167 mμ (or 189 mμ depending upon the equation) to 220 mμ in passing to the acetate (II) might suggest that the latter grouping gives rise to an optically active absorption band in that region. The equation, however, does not fit beyond 420 mμ, which presumably limits its significance. The λ_0 values for cholesterol (V) (197 mμ) and Δ^6-cholestenol acetate (VI) (203 mμ) are in agreement with expectation, while the corresponding values for the Δ^7-(IV) and $\Delta^{8(14)}$-(III) isomers are abnormally high (265 and 336 mμ, respectively) and no explanation can be offered for this observation.

General Procedure for Obtaining Drude Equations[8]

For the purpose of obtaining the best possible Drude equations to fit the experimental values use was made of the Unitized Digital Electronic Computer (UDEC) of the Wayne University Computation Laboratory. For each set of results both one-term and two-term Drude equations were tried, by the following methods:

One-term Equations.—Such equations are of the form $[M] = K/(\lambda^2 - \lambda_0^2)$ and involve two constants, which normally have to be calculated from two sets of experimental values. An equation thus obtained then must be checked against the remaining values, and if the fit is not satisfactory a different set of constants then can be calculated from two other sets of experimental values, and so on until a satisfactory fit (if any) is obtained. This method is laborious, even with the help of a computing machine, and the method of least squares therefore was adopted to obtain directly the best equation. In this method the differences between the squares of the computed values from an arbitrary equation and experimental values are minimized, and the equation corresponding to the new set of values is obtained. Using the electronic computer, this method was applied routinely first to the first six sets of experimental values, then to the first seven, eight and so on, the equation last obtained taking into account all of the experimental values outside the optically active absorption band, *i.e.*, the region where a Drude equation can be expected to be operative. Different values for the constants K and λ_0 thus obtained were tabulated by the machine; inspection then showed whether these values remained constant as additional experimental data were included. If this was so, a one-term equation with these constant values for K and λ_0 would be expected to fit the experimental results, while if the values showed a constant drift to larger or smaller numbers, it was indicated that a one-term equation could not be applied to that example.

Two-term Equations.—Such equations are normally of the form $[M] = K_1/(\lambda^2 - \lambda_0^2) + K_2/(\lambda^2 - \lambda_1^2)$ the first term expressing the rotatory contribution of a chromophore with an absorption peak at λ_0 and the second term expressing the contribution of another chromophore with a peak at λ_1 which is situated farther in the ultraviolet. It follows that λ_1, which is smaller than λ_0, will be even smaller compared to λ, so that λ_1^2 can be neglected (in comparison with λ^2) without a serious loss in accuracy and with the considerable simplification that only three constants are involved in the equation which then becomes $[M] = K_1/(\lambda^2 - \lambda_0^2) + K_2/\lambda^2$.

In obtaining such equations, the method of least squares caused difficulties and was, therefore, discarded. Instead, groups of three experimental sets of values were used to calculate, with the aid of the electronic computer, sets of constants (K_1, K_2 and λ_0). These were tabulated, inspected and if wide variations were observed, this was taken to mean that a two-term equation was not applicable. However, if all or a significant portion of the tabulated values for the constants (K_1, K_2 and λ_0) did not vary unduly, their arithmetic mean was taken and the resulting set of these three constants was used to set up an equation which then was tested against the experimental values. In later work, twenty-six sets of values for K_1, K_2 and λ_0 usually were computed through the machine and employed in this manner.

Experimental Results[5]

Cholestan-3β-ol (I), m.p. 146–147°. R.D. (Fig. 1): $[\alpha]_{700}$ +17.0°, $[\alpha]_{589}$ +23.8°, $[\alpha]_{290}$ +130.5°; c = 1.00; temp. 23–25°. Drude equation: One-term, $[M] = 29.6/(\lambda^2 - 0.0279)$; λ_0 167 mμ; % deviation $[M]_{\text{obsd.}} - [M]_{\text{calcd}}$: ±1.0%, 650–310 m$\mu$. Two-term, $[M] = 22.7/(\lambda^2 - 0.0356) + 7.07/\lambda^2$; λ_0 189 mμ; % deviation $[M]_{\text{obsd}} - [M]_{\text{calcd}}$: ±1.6%, 650–330 m$\mu$.

Cholestan-3β-ol-acetate (II), m.p. 113–114°. R.D. (Fig. 1): $[\alpha]_{700}$ + 9.2°, $[\alpha]_{589}$ + 13.3°, $[\alpha]_{290}$ + 81.0°; c = 1.00; temp. 23–25°. Drude equation: $[M] = 17.5/(\lambda^2 - 0.0486)$; λ_0 220 mμ; % deviation $[M]_{\text{obsd}} - [M]_{\text{calcd}}$: ±2.3%, 700–420 m$\mu$.

$\Delta^{8(14)}$-**Cholesten-3β-ol-acetate** (III), m.p. 75–77°, furnished by Dr. O. Wintersteiner, E. R. Squibb & Sons. R. D. (Fig. 1): $[\alpha]_{700}$ + 6.8°, $[\alpha]_{589}$ + 9.2, $[\alpha]_{320}$ + 17.2°, slight "max." $[\alpha]_{380}$ + 21.5°; c = 1.00; temp. 24–25°. Drude equation: $[M] = -0.112/(\lambda^2 - 0.113) + 14.9/\lambda^2$; λ_0 336 mμ; % deviation $[M]_{\text{obsd}} - [M]_{\text{calcd}}$: ±2.3%, 650–390 m$\mu$; ±3.2%, 650–380 m$\mu$.

Δ^7-**Cholesten-3β-ol-acetate** (IV), m.p. (104°) 109–110°, supplied by Dr. O. Wintersteiner, E. R. Squibb & Sons. R. D. (Fig. 1): $[\alpha]_{700}$ +6.5°, $[\alpha]_{589}$ + 8.0°, $[\alpha]_{290}$ − 49.4; gradual "max." $[\alpha]_{430-440}$ + 11.2°; c = 1.00; temp. 23–25°. Drude equation: $[M] = -9.14/(\lambda^2 - 0.070) + 23.6/\lambda^2$; λ_0 265 mμ; % deviation $[M]_{\text{obsd}} - [M]_{\text{calcd}}$: ±2.4%, 650–360 m$\mu$.

Δ^5-**Cholesten-3β-ol** (V), m.p. 152.5–154°, supplied by Dr. L. F. Fieser, Harvard University. R. D. (Fig. 1): $[\alpha]_{700}$

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[7] The constant K in a one-term Drude equation is in effect the rotation (referred to as "absolute rotatory power" by T. M. Lowry and T. W. Dickson, *J. Chem. Soc.*, **103**, 1067 (1913)) at 1 μ in the near infrared and it has been used for such a purpose in the past (M. Betti, *Trans. Faraday Soc.*, **26**, 337 (1930)).

[8] For further details, see Ph.D. thesis of E. W. Foltz, Wayne University, 1955.

$-26.6°$, $[\alpha]_{589}$ $-37.2°$, $[\alpha]_{290}$ $-250.4°$; $c = 1.00$; temp. 24–25°. Drude equation: $[M] = -48.2/(\lambda^2 - 0.0387) + 4.37/\lambda^2$; λ_0 197 mμ; % deviation $[M]_{obsd} - [M]_{calcd}$: ±0.9%, 620–310 mμ; ±1.6%, 650–300 mμ.

Δ⁶-Cholesten-3β-ol-acetate (VI), m.p. 106–108°, furnished by Dr. O. Wintersteiner, E. R. Squibb & Sons. R. D. (Fig. 1): $[\alpha]_{700}$ $-64.8°$, $[\alpha]_{589}$ $-88.4°$, $[\alpha]_{300}$ $-642.6°$; $c = 1.00$; temp. 24–25°. Drude equation: $[M] = -170/(\lambda^2 - 0.0414) + 58.1/\lambda^2$; λ_0 203 mμ; % deviation $[M]_{obsd} - [M]_{calcd}$: ±0.8%, 620–310 mμ; ±1.5%, 620–300 mμ; ±2.5%, 650–300 mμ.

Δ⁴-Cholesten-3-one (VII), m.p. 80–81°; $\lambda_{max.}$ 320–323, 327–332 mμ, log ε 2.00, 2.00, shoulder 349 mμ, log ε 1.81; inflections 357, 367 mμ, log ε 1.62, 1.49. R. D. (Fig. 2): $[\alpha]_{700}$ $+60°$, $[\alpha]_{589}$ $+82°$, $[\alpha]_{280}$ $+1900°$, "max." $[\alpha]_{420}$ $+161$, "min." $[\alpha]_{365}$ $-123°$, "max." $[\alpha]_{360}$ $-80°$, "min." $[\alpha]_{350}$ $-164°$, "max." $[\alpha]_{285-290}$ $+2006°$; $c = 0.10$; temp. 24–25°. R. D.: $[\alpha]_{700}$ $+56.9°$, $[\alpha]_{589}$ $+82.2°$, $[\alpha]_{390}$ $+127.2°$, "max." $[\alpha]_{415-420}$ $+152.4°$; $c = 1.00$; temp. 24–25°. Drude equation: $[M] = 101/(\lambda^2 - 0.0301)$, from $c = 1.00$ data; λ_0 173 mμ; % deviation $[M]_{obsd} - [M]_{calcd}$: ±1.1%, 700–525 mμ; ±1.9%, 700–500 mμ; ±2.8%, 700–475 mμ.

Δ¹-Cholesten-3-one (VIII), m.p. 93.5–95°; $\lambda_{max.}$ 316–326 mμ, log ε 1.93; inflections 343, 357, log ε 1.83, 1.67. R. D. (Fig. 2): $[\alpha]_{700}$ $+44.2°$, $[\alpha]_{589}$ $+59.6°$, $[\alpha]_{300}$ $+1097°$, "max." $[\alpha]_{470}$ $+84°$, "min." $[\alpha]_{382.5}$ $-212°$, "max." $[\alpha]_{370-372.5}$ $-78°$, "min." $[\alpha]_{365}$ $-110°$, "max." $[\alpha]_{315}$ $+1205°$; $c = 0.10$; temp. 24°.

Cholestan-3-one (IX), m.p. 129–130°; $\lambda_{max.}$ 284–292 mμ, log ε 1.46. R. D. (Fig. 2): $[\alpha]_{700}$ $+29.3°$, $[\alpha]_{589}$ $+40.2°$, $[\alpha]_{285}$ $-466°$, "max." $[\alpha]_{315}$ $+692°$; $c = 1.00$ from 700–310 mμ, $c = 0.10$ from 360–285 mμ; temp. 23–24°. Drude equation: $[M] = 17.4/(\lambda^2 - 0.0970) + 29.6/\lambda^2$; λ_0 311 mμ; % deviation $[M]_{obsd} - [M]_{calcd}$: ±1.4%, 650–350 mμ.

3,5-Cyclocholestan-6-one (X), m.p. 100–102°; $\lambda_{max.}$ 287–289 mμ, log ε 1.65. R. D. (Fig. 2): $[\alpha]_{700}$ $+35.4°$, $[\alpha]_{589}$ $+48.0°$, $[\alpha]_{295}$ $+515°$, "max." $[\alpha]_{410}$ $+82.8°$, "min." $[\alpha]_{317.5}$ $-664°$; $c = 1.00$ from 700–340 mμ, $c = 0.10$ from 340–295 mμ; temp. 24–25°. Drude equation: $[M] = -19.7/(\lambda^2 - 0.149) + 67.4/\lambda^2$; λ_0 386 mμ; % deviation $[M]_{obsd} - [M]_{calcd}$: ±0.3%, 650–440 mμ.

3,5-Cyclo-Δ⁶-cholestene (XI), m.p. 69–70°; slight $\lambda_{max.}$ 265–267 mμ, log ε 2.04, shoulders 289, 277 mμ, log ε 1.72, 1.86; inflection 285 mμ, log ε 1.79. R. D. (Fig. 2): $[\alpha]_{700}$ $-25.8°$, $[\alpha]_{589}$ $-36.4°$, $[\alpha]_{300}$ $-320°$; $c = 1.00$ from 700–325 mμ, $c = 0.10$ from 330–300 mμ; temp. 23–25°. Drude equation: $[M] = 288/(\lambda^2 - 0.0199) - 261/\lambda^2$; λ_0 141 mμ; % deviation $[M]_{obsd} - [M]_{calcd}$: ±0.7%, 520–350 mμ; ±2.2%, 550–315 mμ.

Acknowledgment.—We are grateful to the National Science Foundation which made the initiation of this research problem possible by a generous grant defraying the cost of the instrument; furthermore, fellowship support to one of us (E.W.F.) also was provided by the National Science Foundation. We should like to acknowledge the kind coöperation of the various investigators listed in papers I, II and III for supplying samples and the assistance in the mathematical treatment furnished by staff members (A. Tanaka, S. Rosen, S. Conte, and A. W. Jacobson) of the Wayne Computation Laboratory.

DETROIT, MICHIGAN

[CONTRIBUTION FROM THE SLOAN-KETTERING INSTITUTE FOR CANCER RESEARCH]

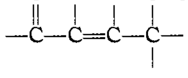
Deacetoxylation of Steroid Ring C Ketol Acetates[1]

BY R. S. ROSENFELD AND T. F. GALLAGHER

RECEIVED MARCH 14, 1955

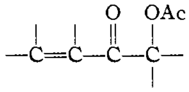
When methyl 3α,11β-diacetoxy-12-ketocholanate or methyl 3α,12α-diacetoxy-11-ketocholanate, which have the ring C acetoxy group in the axial conformation, are refluxed with zinc in glacial acetic acid, methyl 3α-acetoxy-12-ketocholanate and methyl 3α-acetoxy-11-ketocholanate, respectively, are obtained in good yields. However, when methyl 3α,11α-diacetoxy-12-ketocholanate and methyl 3α,12β-diacetoxy-11-ketocholanate, ring C acetoxy groups equatorial, are subjected to the same reaction conditions, the yield of the corresponding monoacetoxy keto cholanic ester is markedly diminished. A similar deacetoxylation has been observed in the sapogenin series.

Several examples of the deacetoxylation of ketol acetates by means of zinc and acetic acid have been reported. Two types of ketol acetates have been shown to undergo deacetoxylation under these conditions: (1) 1,4-ketol acetates, where the functional groups are separated by unsaturation[2]



$$-\overset{\overset{\displaystyle O}{\|}}{C}-\overset{|}{C}=\overset{|}{C}-\underset{|}{\overset{\overset{\displaystyle OAc}{|}}{C}}-$$

and (2) 1,2-ketol acetates, in which the ketone is part of an α,β-unsaturated system.[3]



$$-\overset{|}{C}=\overset{|}{C}-\overset{\overset{\displaystyle O}{\|}}{C}-\underset{|}{\overset{\overset{\displaystyle OAc}{|}}{C}}-$$

This investigation deals with deacetoxylation of steroid ring C ketols with no unsaturation near the reactive centers. The yield in the removal of the acetoxy group depends on its conformation.

When methyl 3α,11β-diacetoxy-12-ketocholanate (I), with the C-11 substituent axial,[4] was refluxed in glacial acetic acid with powdered zinc for 7 hours, the only product isolated was methyl 3α-acetoxy-12-ketocholanate (II) which crystallized directly from the reaction mixture in 64% yield. The epimer of I, methyl 3α,11α-diacetoxy-12-ketocholanate (III), C-11 acetoxy equatorial, would not deacetoxylate under these conditions. However, when the reflux time was extended to 24 hours, partial deacetoxylation of III took place yielding 28% of II and the remainder was the starting ketol acetate III.

Comparable results were obtained with 11-keto-12-acetoxy compounds. Thus, when methyl 3α,12α-diacetoxy-11-ketocholanate (IV), C-12-acetoxyl group axial, was refluxed with zinc in glacial acetic acid for 24 hours, methyl 3α-acetoxy-11-ketocholanate (V) was directly crystallized from the reaction product in 44% yield. Examination of

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[4] E. J. Corey, THIS JOURNAL, **76**, 175 (1954).