ml. of acid was used. Some of the sulfinic acid precipitated from the final solution. This was filtered off, and the filtrate was extracted with three 30-ml. portions of ether. The solid sulfinic acid was dissolved in these ether extracts, and these were then washed with water, dried, and the ether removed to leave an oil which crystallized on standing in a vacuum desiccator, giving 7.4 g. (47%) of α-toluenesulfinic acid, m.p. 64–69° (lit.,[11] 61–63°).

Benzenesulfenyl chloride[12] (1.45 g., 0.01 mole) was dissolved in 90 ml. of benzene and this solution was shaken for 1 hr. in a separatory funnel with a solution of 1.56 g. (0.01 mole) of α-toluenesulfinic acid in 60 ml. of water. The layers were then separated; the benzene layer was washed first with 25 ml. of saturated sodium bicarbonate, then with water, and was finally dried over sodium sulfate. Removal of the benzene under reduced pressure gave a crystalline residue. This was recrystallized twice from ethanol, giving 1.5 g. (57%) of phenyl α-toluenethiolsulfonate, m.p. 110–111°. Its infrared spectrum showed the expected strong sulfonyl group absorptions at 1325 and 1125 cm.$^{-1}$.

Anal. Calcd. for $C_{13}H_{12}O_2S_2$: C, 59.06; H, 4.58; S, 24.26; Found: C, 58.83; H, 4.48; S, 24.51.

Carboethoxymethyl α-Toluenethiolsulfonate.—Potassium α-toluenethiolsulfonate was prepared by the procedure of Boldyrev and Kofman.[10] The salt (0.79 g., 3.5 mmoles) was dissolved in a solution consisting of 30 ml. of purified acetone and 1.5 ml. of water. The solution was filtered and 0.43 g. (3.5 mmoles) of ethyl chloroacetate was added. The solution, which began to deposit potassium chloride almost immediately, was allowed to stand at room temperature for 24 hr. The precipitated potassium chloride was then filtered off, the acetone–water removed under reduced pressure, and the residue taken up in 20 ml. of chloroform. The chloroform solution was dried over sodium sulfate, the chloroform removed, and the solid residue was recrystallized from ethanol. There was obtained 0.42 g. (44%) of carboethoxymethyl α-toluenethiolsulfonate, m.p. 75–76°.

Anal. Calcd. for $C_{11}H_{14}O_4S_2$: C, 48.15; H, 5.14; S, 23.38. Found: C, 47.95; H, 5.12; S, 23.36.

Procedure for Kinetic Runs.—This was the same as that previously described[1,2] as was also the purification of the solvent employed.

Identification of Decomposition Products.—In each case product studies were carried out using the reaction solutions remaining at the end of a kinetic run. The methyl benzoate solvent was removed by fractional distillation under reduced pressure through a short Vigreux column.

In the case of the phenyl ester the residue from the distillation was crystallized from 80% ethanol, yielding a portion of the *benzyl phenyl sulfide* in a quite pure state, m.p. 42–43°, identified by mixed melting point and infrared comparison with a known sample.[13] The filtrate was evaporated, and the residue was chromatographed on acid-washed alumina (50 g./g. residue). Elution with hexane and various hexane–benzene mixtures gave, first, a small amount of *diphenyl disulfide*, identified by comparison with a known sample, followed by the remaining benzyl phenyl sulfide. From a run involving 4.0 mmoles of thiolsulfonate there was obtained 3.2 mmoles of sulfide and 0.13 mmole of the disulfide. The amount of sulfur dioxide evolved was 3.84 mmoles.

With the carboethoxymethyl ester the residue was chromatographed directly. Trial experiments with synthetic mixtures had shown that it was possible to separate mixtures of ethyl S-benzylthioglycolate, diethyl dithiodiglycolate, and methyl benzoate in this manner if the column was eluted first with hexane, then with hexane–benzene containing gradually increasing amounts of benzene, and finally with pure benzene. From a run involving 1.37 g. of thiolsulfonate there was obtained 0.543 g. of liquid having an infrared spectrum identical with that of a known sample[14] of ethyl S-benzylthiolglycolate. The identity of this material was confirmed by basic hydrolysis to the known[14] S-benzylthioglycolic acid, m.p. 64–65°. The only other product fraction from the chromatography (0.25 g.) was eluted at the point where diethyl dithiodiglycolate would be expected to appear. However, although its infrared spectrum suggested it might contain some of this material, there was clearly much of this fraction which was not the disulfide since acid hydrolysis, which on a known sample of diethyl dithiodiglycolate[15] easily afforded dithiodiglycolic acid, m.p. 108–109°, gave only an oil which resisted all attempts at crystallization.

Acknowledgment.—This work was supported by National Science Foundation Grant NSF G-19503.

(11) B. Holmberg, *Arkiv. Kemi, Min., Geol.*, **14A**, No. 8 (1940).
(12) H. Lecher and F. Holschneider, *Ber.*, **57**, 755 (1924).
(13) R. Pummerer, *ibid.*, **43**, 1406 (1910).
(14) R. Lesser and A. Mehrlander, *ibid.*, **56**, 1643 (1923).
(15) T. S. Price and D. F. Twiss, *J. Chem. Soc.*, **93**, 1645 (1909).

Derivatives of Oxytryptophol[1]

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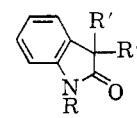
In connection with our general study of the chemistry of oxindole compounds[3] it was of interest to synthesize oxytryptophol (Ia). Whereas none of the routes which were investigated led to the desired compound, the reactions involved are of intrinsic interest and form the basis of the present report.



Ia. R = R″ = H, R′ = $(CH_2)_2OH$
b. R = R″ = H, R′ = Et
c. R = Et, R′ = R″ = H
d. R = $(CH_2)_2OH$, R′ = R″ = H
e. R = $(CH_2)_2Br$, R′ = R″ = H
f. R = Me, R′ = $(CH_2)_2Br$, R″ = H
g. R = R″ = H, R′ = $(CH_2)_2OC_6H_5$

Hydrogenation of 3-(α,β-dihydroxyethylidene)-oxindole (IIa), the product of a Claisen condensation of oxindole and ethyl glycolate whose infrared and ultraviolet spectral properties now confirmed its previously suggested structure,[4] has been reported[4] to lead to unidentifiable products. When on repetition of this experiment similar difficulties were encountered, IIa was acetylated and the resulting diacetate (IIb) hydrogenated

(1) This work was supported in part by a grant (MY-1301) by the Public Health Service, U.S. Department of Health, Education, and Welfare.
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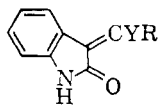
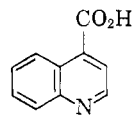
(3) E. Wenkert, J. H. Udelhofen, and N. K. Bhattacharyya, *J. Am. Chem. Soc.*, **81**, 3763 (1959), and previous papers.
(4) L. Horner, *Ann.*, **548**, 117 (1941).

over palladium–charcoal. Unfortunately, extensive hydrogenolysis took place leading only to 3-ethyloxindole (Ib).



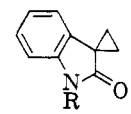
IIa. R = CH_2OH, Y = OH
b. R = CH_2OAc, Y = OAc
c. R = $CH_2OC_6H_5$, Y = OH
d. R = $CH_2OC_6H_5$, Y = H

The state of oxidation of the polyfunctional side chain in IIa and its potential ability to aid in a hydrolytic ring opening of the otherwise stable oxindole nucleus[5] as well as to engage in multiple tautomerism and in hydration–dehydration reactions suggested that it may undergo a facile rearrangement to cinchoninic acid (III). Indeed, exposure of IIa to dilute aqueous acid yielded the quinoline derivative III. This rearrangement represents an oxindole model for the postulated biosynthetic conversion of natural indole bases, *e.g.* cinchonamine, to the quinoline-type Cinchona alkaloids.[6]



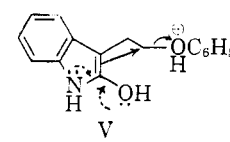
III

Oxytryptophol (Ia) has been claimed, in a preliminary report in 1955, to have been prepared from oxindole and ethylene oxide.[7] While the experimental data of this reaction were not available, its re-study was undertaken. Sodium ethoxide-induced alkylation led to a hydroxyethyloxindole whose treatments first with hydrobromic acid and then with hydrogen and palladium–charcoal gave N-ethyloxindole (Ic). Thus in our hands the reaction of oxindole and ethylene oxide had yielded only 1-(β-hydroxyethyl)oxindole (Id). The low yield of this substance suggested that conceivably polyhydroxyethylation had occurred, but no other products could be characterized. In this connection it is noteworthy that alkylation of oxindole with alkyl halides and alkoxide bases leads to both N- and C-alkylated products. In contrast to a previous report[8] a reaction with ethyl iodide gave both N-ethyloxindole (Ic) and 3-ethyloxindole (Ib).[9] Alkylation with ethylene dibromide, a halide well known to undergo displacements only sluggishly, led only to recovery of oxindole. However, when potassium *t*-butoxide was used as the base, 1-(β-bromoethyl)oxindole (Ie) and 3,3-dimethyleneoxindole (IVa) were produced. The structure of the former was confirmed by its catalytic hydrogenolysis to N-ethyloxindole (Ic), while the latter product and its N-methyl derivative (IVb), prepared by the reaction of the sodio salt of IVa with dimethyl sulfate, were identified by comparison with authentic samples.[10]



IVa. R = H
b. R = Me

On the assumption that oxytryptophol (Ia) might be prepared by a hydrolysis of 3-(β-bromoethyl)oxindole, a synthesis of the latter, modeled after the reported preparation of its N-methyl derivative (If),[11] was attempted. Claisen condensation of oxindole and ethyl phenoxyacetate yielded 3-(α-hydroxy-β-phenoxyethylidene)-oxindole (IIc), which on hydrogenation over palladium–charcoal and dehydration gave 3-(β-phenoxyethylidene)oxindole (IId). Hydrogenation of IId produced the oxindole Ig. Whereas the latter's N-methyl derivative has been shown to be converted to If on treatment with fuming hydrobromic acid,[11] a similar reaction transformed Ig into the spiro compound IVa. This curious acid-catalyzed, internal displacement, presumably taking place *via* path V, probably has occurred unnoticedly in the N-methyl series[11] also. However in that case the intermediate spiro system IVb is labile in acid solution and hence converted to If.[10,11]



V

Experimental

3-(α,β-Diacetoxyethylidene)oxindole (IIb).—A solution of 250 mg. of 3-(α,β-dihydroxyethylidene)oxindole (IIa)[4] [spectra: ultraviolet (95% ethanol), λ_{max} 264 mμ (log ε 4.26), 302 mμ (log ε 3.94), λ_{min} 233 mμ (log ε 3.60), 275 mμ (log ε 3.61); infrared ($CHCl_3$), OH, NH 2.91 (w), 3.07 (w) μ, C=O 5.81 (m), 6.01 (s) μ, C=C 6.17 (s) μ] and 25 mg. of *p*-toluenesulfonic acid in 10 ml. of acetic anhydride was left standing at room temperature for 36 hr. Cold water and ether were added, the mixture washed with 10% sodium bicarbonate solution and with water and the ethereal solution dried over anhydrous sodium sulfate. Vacuum removal of the ether yielded 396 mg. of a yellow solid, m.p. 160–170°, which on crystallization from ethyl acetate–ether gave yellow prisms of IIb, m.p. 160°, changed to needles, m.p. 174°; spectra: ultraviolet (95% ethanol), λ_{max} 252 mμ (log ε 4.30), 258 mμ (log ε 4.33), and 296 mμ (log ε 3.69);

(5) E. Wenkert and T. L. Reid, *Experientia*, **10**, 417 (1954).

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(7) F. M. Miller and R. M. Gamson, Abstracts of the 127th National Meeting of the American Chemical Society, Cincinnati, Ohio, March 29–April 7, 1955, p. 2-N.

(8) A. Baeyer and W. J. Comstock, *Ber.*, **16**, 1704 (1883).

(9) Alkylation with isopropyl iodide led similarly to N- and C-isopropyl products (J. C. Orr, unpublished observation).

(10) E. Wenkert, N. K. Bhattacharyya, T. L. Reid, and T. E. Stevens, *J. Am. Chem. Soc.*, **78**, 797 (1956).

(11) P. L. Julian, A. Magnani, J. Pikl, and W. Karpel, *ibid.*, **70**, 174 (1948).

infrared ($CHCl_3$), NH 2.91 (w) μ, C=O, C=C 5.62 (s), 5.73 (s), 5.81 (s), 6.02 (s), 6.17 (s) μ.

Anal. Calcd. for $C_{14}H_{13}NO_5$: C, 61.09; H, 4.76; N, 5.09. Found: C, 61.19; H, 5.11; N, 5.13.

A mixture of 40 mg. of the diacetate IIb and 10 mg. of 5% palladium–charcoal in 50 ml. of 95% ethanol was hydrogenated under 46 p.s.i. of hydrogen for 3 hr. The mixture was filtered and the solution evaporated. The residue was washed with water and taken up in ether. The organic solution was dried over sodium sulfate and evaporated yielding 20 mg. of a solid, m.p. 96–100°. Crystallization of the latter from benzene–hexane gave 3-ethyloxindole (Ib), m.p., m.m.p. 100–102°; infrared spectrum identical with that of an authentic sample.

A mixture of 35 mg. of the diol IIa and 50 ml. of 5% hydrochloric acid was refluxed for 2 hr. Filtration and drying of the reddish precipitated solid yielded 20 mg. of cinchoninic acid (III),[12] m.p., m.m.p. 248–255°; its acid chloride hydrochloride,[13] m.p., m.m.p. 168–170°; infrared spectra (KBr) identical with those of authentic samples. Cinchoninic acid could be obtained in 39% yield when the reaction was carried out at room temperature for 72 hr.

Ethyloxindoles (Ib and Ic).—A sodium ethoxide solution (175 mg. of sodium in 30 ml. of ethanol) of 1.00 g. of oxindole and 1.25 g. of ethyl iodide was refluxed for 11 hr. The solution was evaporated to half its volume, acidified with 5% hydrochloric acid, and extracted with chloroform. The extract was dried over sodium sulfate and evaporated under vacuum. Chromatography of the residue over alumina and elution with petroleum ether yielded 314 mg. of N-ethyloxindole (Ic), m.p. 93–94° (lit.,[8] m.p. 95–93°). Elution with 1:1 petroleum ether–benzene gave 95 mg. of a solid, m.p. 98–100°, whose crystallization from benzene–hexane yielded 3-ethyloxindole (Ib),[14] m.p., m.m.p. 102–104°. Elution with ether led to a recovery of 342 mg. of oxindole.

1-(β-Hydroxyethyl)oxindole (Id).—A sodium ethoxide solution (1.15 g. of sodium in 40 ml. of ethanol) of 6.65 g. of oxindole and an excess of freshly distilled ethylene oxide was left standing for 0.5 hr. at 0° and then refluxed for 4 hr. More oxide was added at *ca.* the halfway point of the reaction. Upon work-up and alumina chromatography as above 1.95 g. of oxindole was recovered from the benzene eluates, while elution with 6:1 benzene–ether yielded 900 mg. of a solid 135–138°. Crystallization of the latter from ethyl acetate gave Id, m.p. 140°; spectra: ultraviolet (95% ethanol), λ_{max} 251 mμ (log ϵ 4.00), infrared ($CHCl_3$), OH, NH 2.86 (w), 2.91 (w) μ, C=O 5.87 (s) μ, C=C 6.18 (m), 6.22 (w) μ.

Anal. Calcd. for $C_{10}H_{11}NO_2$: C, 67.78; H, 6.26; N, 7.91. Found: C, 67.52; H, 6.17; N, 7.67.

A mixture of 89 mg. of alcohol Id and 30 ml. of 48% hydrobromic acid was heated at 100° for 90 min. under nitrogen. Upon the addition of water the mixture was extracted with ether. The extract was dried over sodium sulfate and evaporated. Since the resulting red oily residue, 20 mg., could not be induced to crystallize, it was mixed with 30 mg. of 5% palladium–charcoal, 40 mg. of sodium bicarbonate, 10 ml. of 95% ethanol, and 3 ml. of water, and the mixture was hydrogenated for 18 hr. under 35 p.s.i. of hydrogen. The mixture was filtered and evaporated and the residue taken up with water and extracted with ether. Evaporation of the extract, chromatography on alumina and elution with benzene yielded 11 mg. of N-ethyloxindole (Ic), m.p., m.m.p. 93–94°.

3,3-Dimethyleneoxindole (IVa).—A mixture of 1.33 g. of oxindole, 7.50 g. of ethylene dibromide in a potassium *t*-butoxide solution (391 mg. of potassium in 50 ml. of *t*-butyl alcohol) was refluxed under nitrogen for 12 hr. The mixture was filtered and worked up in the same manner as the above alkylations. Alumina chromatography and elution with 1:1 ligroin–benzene gave 198 mg. of a solid, m.p. 63–65°. Crystallization from benzene–hexane yielded 1-(β-bromoethyl)oxindole (Ie), m.p. 77°; infrared spectrum ($CHCl_3$), C=O 5.84 (s) μ, C=C 6.18 (m), 6.22 (w) μ. Its structure was shown to be Ie by its catalytic hydrogenation, in the manner described above, in 88% yield to N-ethyloxindole (Ic), m.p., m.m.p. 94–96°.

Anal. Calcd. for $C_{10}H_{10}BrNO$: N, 5.83. Found: N, 5.77.

Continued elution with ether yielded 8 mg. of 3,3-dimethyleneoxindole (IVa), m.p., m.m.p. 186–187°. Treatment of 55 mg. of this compound with sodium ethoxide (8 mg. of sodium in 2 ml. of ethanol) under nitrogen and vacuum removal of the solvent led to the sodio salt of IVa. It was suspended in ether, treated with 2.5 g. of dimethyl sulfate and the mixture allowed to stand at room temperature for 5 hr. The solvent and excess methylating agent was removed under vacuum and the residue treated with 5% sodium hydroxide solution and ether. The organic extract was evaporated and chromatographed on alumina. Elution with hexane gave 10 mg. of 1-methyl-3,3-dimethyleneoxindole (IVb), m.p., m.m.p. 81–83° (lit.,[10] m.p. 81–82°); infrared spectrum identical with that of an authentic sample.

Further elution of the products from the oxindole–ethylene bromide run with chloroform gave 742 mg. of oxindole, while elution with acetone yielded 70 mg. of an unidentified solid, m.p. 127–128° (not oxindole).

3-(β-Phenoxyethyl)oxindole (Ig).—A solution of 4.25 g. of oxindole, 7 ml. of ethyl phenoxyacetate, and sodium ethoxide (1.00 g. of sodium in 30 ml. of ethanol) was refluxed for 2 hr. The precipitated solid was filtered and shaken with 5% hydrochloric acid solution. It was filtered and dried. Crystallization of the solid, 8.12 g., from aqueous ethanol yielded gray needles, m.p. 136–138°, which on recrystallization from methylene chloride–hexane afforded colorless needles of 3-(α-hydroxy-β-phenoxyethylidene)oxindole (IIc), m.p. 138°; spectra: ultraviolet (95% ethanol), λ_{max} 266 mμ (log ϵ 4.46), 308 mμ (log ϵ 4.13), λ_{min} 237 mμ (log ϵ 3.79), 279 mμ (log ϵ 3.78); infrared ($CHCl_3$), OH, NH 2.89 (m), 3.10 (w) μ, C=O 5.97 (s), 6.09 (m) μ, C=C 6.23 (m), 6.27 (w) μ.

Anal. Calcd. for $C_{16}H_{13}NO_3$: C, 71.90; H, 4.90; N, 5.24. Found: C, 71.86; H, 5.21; N, 5.21.

A mixture of 5.34 g. of IIc and 2 g. of 5% palladium–charcoal in 200 ml. of 95% ethanol were hydrogenated for 2 hr. at 45 p.s.i. of hydrogen pressure. Filtration of the mixture and evaporation of the solvent gave 4.59 g. of an amorphous solid. Treatment of 4.28 g. of the latter with 0.2 ml. of concentrated sulfuric acid in 100 ml. of glacial acetic acid for 16 hr. at room temperature and addition of ice–water thereafter led to 4.04 g. of a solid. Crystallization from methylene chloride–hexane yielded pale yellow needles of 3-(β-phenoxyethylidene)oxindole (IId), m.p. 143°; spectra: ultraviolet (95% ethanol), λ_{max} 256 mμ (log ϵ 4.50), 292 mμ (log ϵ 3.80), 365 mμ (log ϵ 3.20), λ_{min} 230 mμ (log ϵ 3.86), 270 mμ (log ϵ 3.15), 325 mμ (log ϵ 2.96); infrared ($CHCl_3$) OH, NH 2.89 (m), 3.11 (w) μ, C=O 5.81 (s), 5.85 (s) μ, C=C 6.03 (m), 6.16 (s), 6.24 (s), 6.28 (m) μ.

Anal. Calcd. for $C_{16}H_{13}NO_2$: C, 76.47; H, 5.22; N, 5.67. Found: C, 76.23; H, 5.36; N, 5.55.

Hydrogenation of 3.00 g. of IId and 1.25 g. of 10% palladium–charcoal in 125 ml. of 95% ethanol was carried out in the manner described above and led to 1.90 g. of a solid, m.p. 100–103°. Crystallization from benzene–hexane yielded colorless prisms of 3-(β-phenoxyethyl)oxindole (Ig), m.p. 108°; spectra: ultraviolet (95% ethanol), λ_{max} 248 mμ (log ϵ 3.82), $\lambda_{shoulder}$ 278 mμ (log ϵ 3.27), λ_{min} 232 mμ (log ϵ 3.41); infrared ($CHCl_3$), NH 2.90 (m), 3.12 (w) μ, C=O 5.82 (s) μ, C=C 6.15 (s), 6.23 (s), 6.29 (m) μ.

(12) R. R. Renshaw and H. L. Friedman, *J. Am. Chem. Soc.*, **61**, 3320 (1939).

(13) H. Meyer, *Monatsh.*, **22**, 115 (1901).

(14) E. Wenkert, B. Bernstein, and J. H. Udelhofen, *J. Am. Chem. Soc.*, **80**, 4899 (1958).

Anal. Calcd. for $C_{16}H_{15}NO_2$: N, 5.53. Found: N, 5.65.

A mixture of 1.00 g. of Ig and 25 ml. of 48% hydrobromic acid was refluxed gently (oil-bath temperature of 110°) under nitrogen for 12 hr. Water was added and the mixture extracted with ether and with chloroform. The organic solutions were extracted with 2% sodium hydroxide solution and dried over sodium sulfate. Evaporation of the solvents yielded a residue which on alumina chromatography and elution with ether gave 195 mg. of starting material. Elution with chloroform yielded 172 mg. of a solid, m.p. 160–165°, which on crystallization from ethyl acetate had a m.p. 180–187°. Sublimation (150°, 3 mm.) and recrystallization from ethyl acetate afforded 3,3-dimethyleneoxindole (IVa), m.p. 184–185°; spectra: ultraviolet (95% ethanol), λ_{max} 252 mμ (log ε 3.90), $\lambda_{shoulder}$ 280 mμ (log ε 3.17), λ_{min} 230 mμ (log ε 3.45); infrared (CCl_4) identical with that of an authentic sample.[10]

Anal. Calcd. for $C_{10}H_{11}NO$: C, 75.45; H, 5.70; N, 8.80. Found: C, 75.21; H, 6.02; N, 8.79.

Synthesis of 20-Isocholestane

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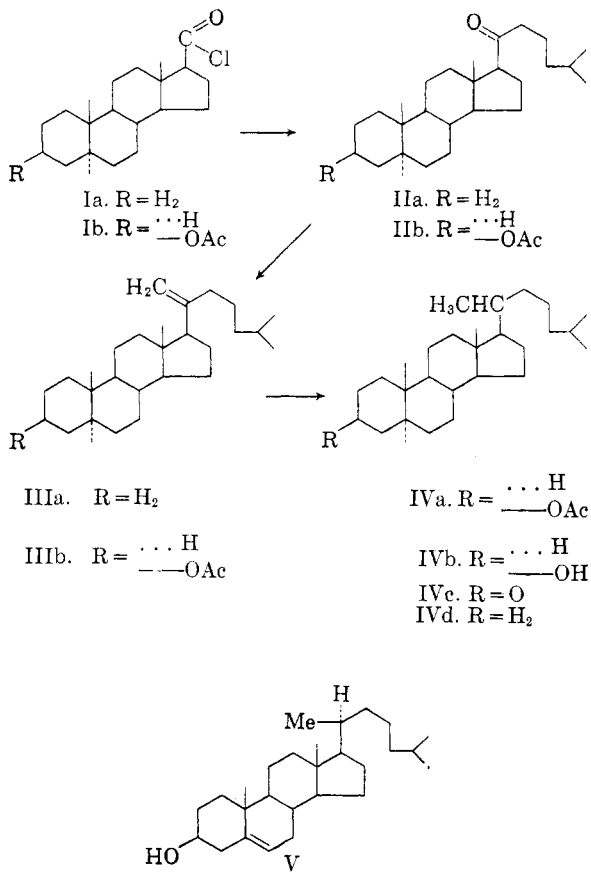
In the course of work directed toward the development of an improved synthetic route to substances with cholesterol side chain, Sondheimer and Mechoulam[1] isolated 20-isocholesterol (V) by selective hydrogenation of 20-dehydrocholesterol. Tsuda and co-workers[2] in Japan obtained 20-isocholesterol as a degradation product from sargasterol; further attempts to synthesize the former failed in their laboratory. Later Tsuda and Sakai[3] synthesized 20-iso-22-dehydrocholesterol from 3β-acetoxy-20α-methylpregn-5-ene-21-al.

In connection with a project under way in this laboratory on the synthesis of 20-isosteroids, we have had occasion to follow up Sondheimer and Mechoulam's[1] synthetic route to the cholesterol side chain for the preparation of 20-isocholestane. Commercially available 3β-hydroxyetioallocholanic acid was converted to etioallocholanic acid in good yield, and the acid chloride (Ia) of the latter was treated with diisohexylcadmium according to the method described by Kurath[4] to yield 21-nor-20-ketocholestane (IIa). This then was converted to the 20-dehydrocholestane (IIIa) in 50% yield through Wittig's reaction with triphenylphosphinemethylene. Hydrogenation of this compound in ethanol using palladium–calcium carbonate, gave a mixture of cholestanes which could not be resolved by column or gas–liquid chromatography.



Assuming that the 3β-hydroxy group would facilitate resolution of the epimers in a column of alumina, we then started the synthesis with 3β-acetoxyetioallocholanic acid chloride (Ib) to obtain the 21-nor-20-ketocholestan-3β-ol acetate (IIb). This compound, through the Wittig reaction as before, and after acetylation, gave the 20-dehydrocholestanylacetate (IIIb). Hydrogenation of IIIb in ethanol over palladium–calcium carbonate or in glacial acetic acid over platinum oxide, resulted in inseparable mixtures. The mixture of cholestanol acetates thus obtained was hydrolyzed and chromatographed on alumina grade II. Early benzene–ether fractions gave 20-isocholestanol (IVb, 20-iso), and further elution with ether gave cholestanol[5] (IVb, 20-*n*). Oxidation of the 20-isocholestanol to the keto compound (IVc), followed by conversion to the thioketal and reduction with Raney-nickel gave 20-isocholestane (IVd, 20-iso).

(1) F. Sondheimer and R. Mechoulam, *J. Am. Chem. Soc.*, **80**, 3087(1958).

(2) K. Tsuda, R. Hayatsu, Y. Kishida, and S. Akagi, *ibid.*, **80**, 921 (1958).

(3) K. Tsuda and K. Sakai, *Chem. Pharm. Bull.* (Japan), **9**, 529 (1961).

(4) P. Kurath and M. Capezzuto, *J. Am. Chem. Soc.*, **78**, 3527 (1956).

(5) Sondheimer and Mechoulam had tried a complete hydrogenation on 20-dehydrocholesteryl acetate, but could isolate only *ca.* 25% cholestanyl acetate (IVb, 20-*n*), after direct crystallization and chromatography. Our experience with nonpolar acetates and hydrocarbons was similar, but when a double bond (as in cholesteryl acetate) or hydroxyl (as in cholestanol) were present in the molecule, resolution of the epimers on the column became easy.